HPE NFV Director

User Guide

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Second Edition

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Enterprise

Notices

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Printed in the US

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Preface

About this guide

This guide is intended to support the NFV Director user during the NFV Director GUI operations.

Audience

This document is targeting all levels of NFV Director users: Domain users, Organization Users, VDC Users, Group Users, and Datacenter users.

For On boarding VNFs please refer to the *HPE NFV Director On boarding Guide*.

Document history

Table 1: Document history

Edition	Date	Description
1.0	14 October, 2016	First Edition
2.0	2 December 2016	Second edition. Reformatting

Chapter 1
NFV Director Entities and User levels

There are five different entities in NFV-D system and all of them are related. Those entities are the following:

- Domain
- Datacenter
- Organization
- VDC
- VNF Group

The **Domain** is the scope that includes the whole NFV-D system. There is only one Domain and it contains all the other entities. Domain refers to all existing entities in the system.

A **Datacenter** represents a localized physical infrastructure that provides the necessary physical resources for creating virtualized infrastructures. There can be several Datacenters in a Domain, but the use of its resources can be restricted to the rest of the entities.

An **Organization** represents a company or contract that use and manage its own virtualized infrastructures in the Domain. An Organization has to be registered by a Domain User and the Organization entities cannot be shared with another Organization. Two different Organizations can use resources from the same Datacenters, but they can each only use the resources assigned by the Domain based on the quota.

A **VDC** represents a virtual infrastructure where the VNF can be deployed. A VDC can belong to only one Organization (a VDC without an Organization or belonging to more than one is not possible) and it can be registered only by an Organization user.

A **VNF Group** is an entity that contains a set of deployed VNFs inside a VDC. So a VNF belongs to only one VDC. It is intended for management purposes, since a Group User is responsible for managing all VNFs in its VNF Group.

1.1 Domain Level

1.1.1 Domain Entity

A Domain Entity represents all the resources and entities that are available it the scope of an NFV-D implantation. There is only one Domain in an NFVD environment. All NFV-D entities depend on it and all resources are managed by it.

1.1.2 Domain Users

A Domain User can manage the application domain. Their responsibilities include viewing all the domain resources, managing other users, organizations, templates, domain images, organizations quota, and jobs.

It can only be created by another Domain User, and some of the profiles or operations can be revoked.

The profiles and operations available for a Domain User are the following:

Table 2: Domain User Profiles and Operations

Profile	Operations
Administrator	Manage Domain Users Manage Organization Users Manage VDC Users Manage VNF Group Users Manage Datacenter Users
Provisioning	Manage Organizations Manage Quota Catalog Manage Template Catalog Manage Images Grant/Revoke Images View Jobs Manage Jobs
Template Designer	Manage VNF Group Templates Manage VDC Templates
Monitoring	

1.1.3 Domain Resources

Domain Resources are defined by all the available servers and infrastructure in the Datacenters Domain that can be used for virtualization and VNF deployments.

Domain Resources are all the resources of its Datacenters. Follow these steps as a Domain User to view a global summary of all the resources available in the domain.

1) Click **Summary** in the top menu.

Figure 1: Domain Summary option at the top

2) Select **Global View** in the first drop-down list.

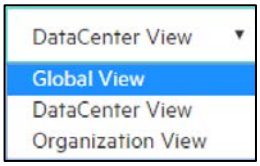


Figure 2: Domain Summary - Global View

You will see a summary of all resources available in the Domain, indicating availability and use. During the first access to the **Summary** without a VIM configured, the **Virtual Load Balancer** and **Virtual Firewalls** tabs could show some resources. In this case the **total** part of **consumed/total** refers to the maximum number of licenses available to be acquired, not to the resources.

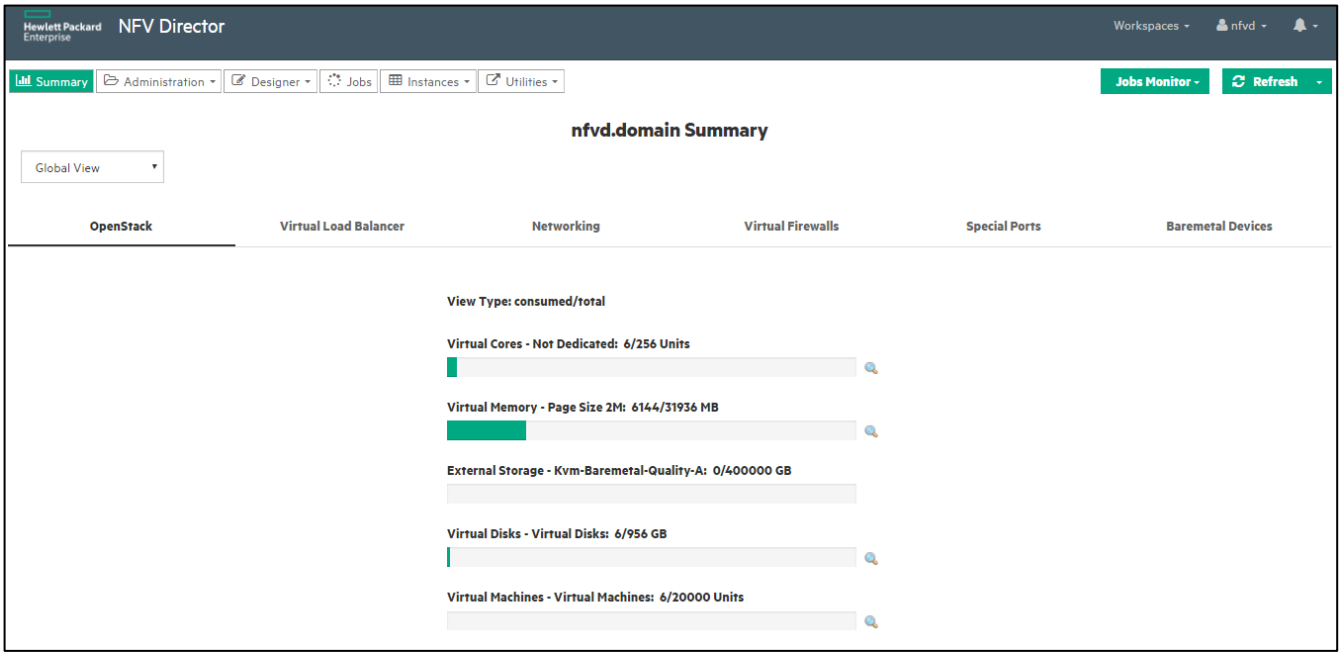


Figure 3: Domain Summary - OpenStack Resources

The resources can be filtered to show those meeting the Best Effort Quotas filter.

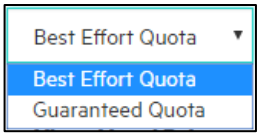


Figure 4: Filter by Best Effort Quotas

Best Effort resources are those which availability is not guaranteed after they have been assigned. It is possible that a resource assigned in **Best Effort mode** cannot be provided.

Following are the resources provided in **Best Effort mode**:

- OpenStack
- Networking
- Virtual Firewalls
- Special Ports
- Baremetal Devices

In contrast, the availability of resources that have been assigned in **Guaranteed mode** is guaranteed. As such, those resources can be assigned to only one entity of the same level (for example, the same guaranteed baremetal server cannot be assigned to two different organizations).

Following are the resources provided in **Guaranteed mode**:

- OpenStack Server Computers
- Baremetal Devices

Clicking on the left icon (magnifying glass) for a resource displays a graph indicating its availability and use by DC and Organization.

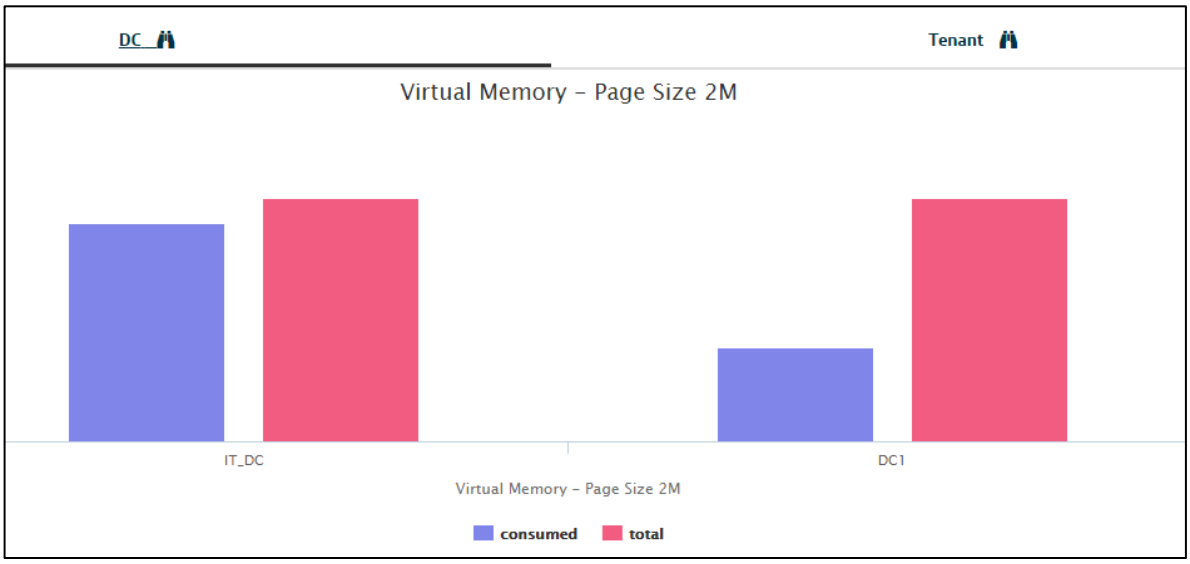


Figure 5: Virtual Memory Page Size 2M resource – availability by Datacenters graph

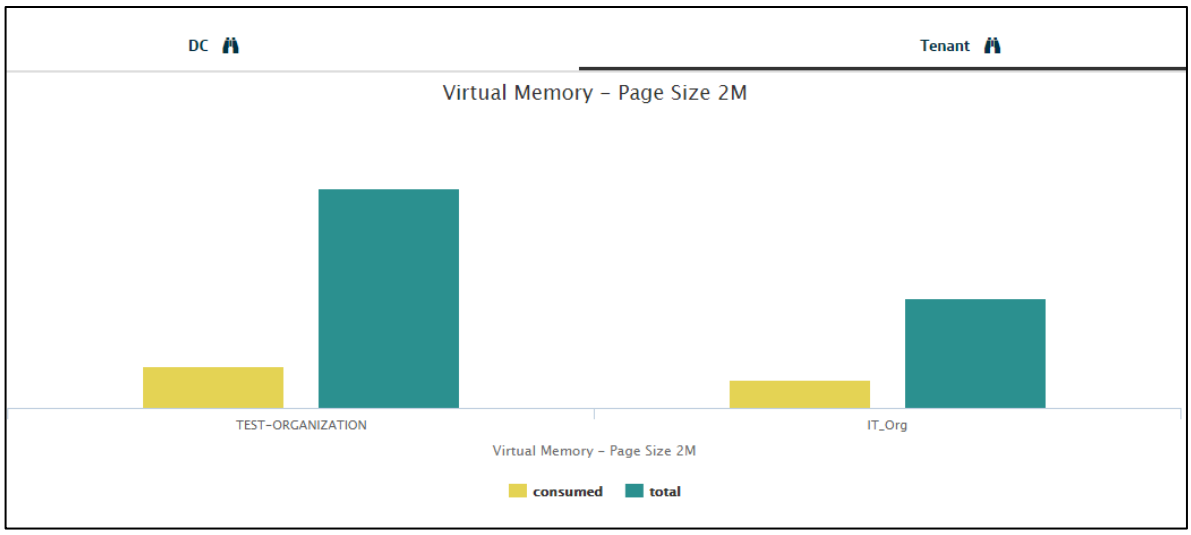


Figure 6: Virtual Memory Page Size 2M resource – availability by Organizations graph

Clicking on **Datacenter View** displays all physical servers in the Domain Datacenters.

1) Select the **Datacenter** with the servers.

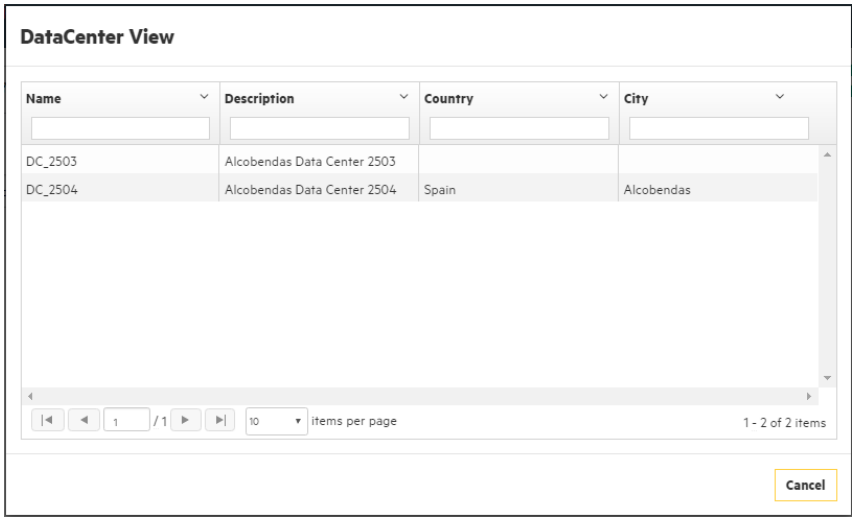


Figure 7: Datacenter selection

Select the **Datacenter** to display its servers.

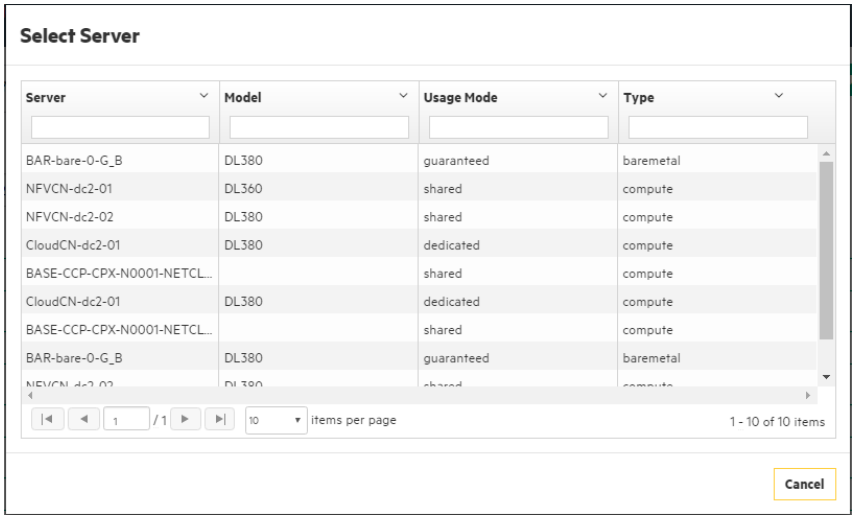


Figure 8: Server selection

2) Select a server to list additional details.

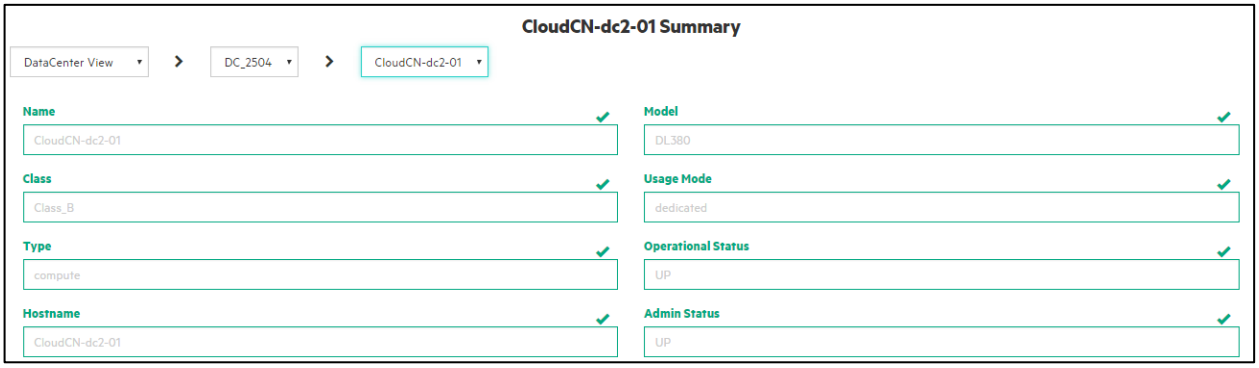


Figure 9: Selected server details

1.1.4 Domain Quota

The Domain is the owner of the resources but it does not have a quota. It manages all available resources in Domain Datacenters.

1.1.5 Domain Catalog

The Domain Catalog is the set of all the available templates in the Domain. The concept of a template is similar to the NFV/NS Descriptor Concept defined in the ETSI MANO standard. It represents the design or modeling of an entity (or a part of an entity).

Currently there is no way of adding templates to a Domain (or removing from it) from the Portal. You have to use the external **Templates Designer**.

However, a user with Domain role is able to set the catalog of an Organization from the Portal using the **VNF Template Catalog** functionality.

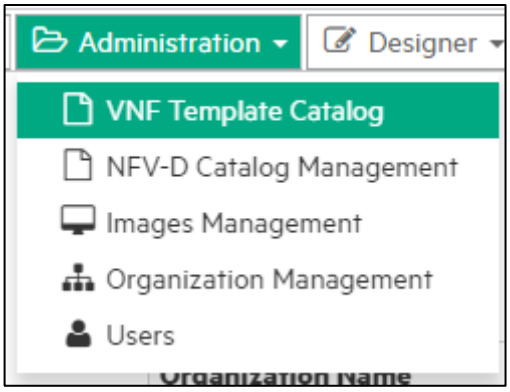


Figure 10: VNF Template Catalog option

The Organization Catalog Management section details how a Domain User can manage the Organization Catalog.

1.1.6 Domain Image Repository

The Domain Image Repository contains all the Operating System Images, which can be deployed in the domain. A Domain User can register and upload an Image from the NFVD Portal and make it either public (accessible to other users) or private.

The NFV Director Images Management chapter details image management.

1.1.7 NFV-D Catalog Management

The Private Catalog is where a Domain User can determine what kinds of quotas can be assigned to the different Organizations.

Follow these steps to manage the Private Catalog of an Organization:

1) Left-click **Management** and select **NFV-D Catalog Management**.

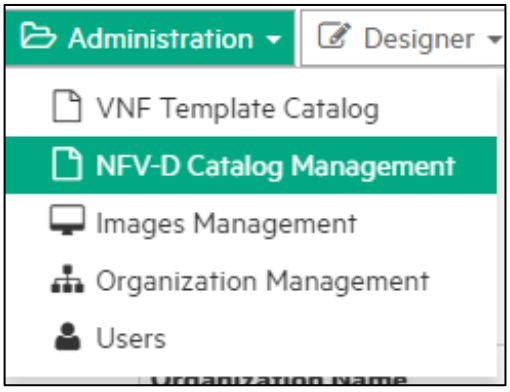


Figure 11: NFV-D Catalog Management option

The following illustration shows all the Organizations in the Domain.

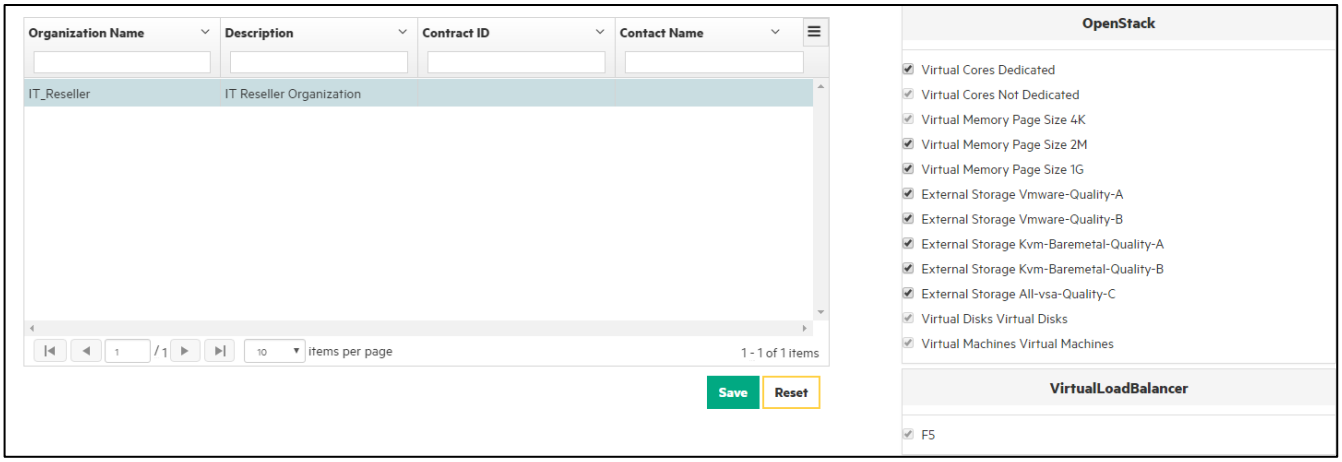


Figure 12NFV-D Catalog Management

2) Select an **Organization** to manage its Private Catalog.

   The right side of the screen contains a table with all the quota types: **Best Effort** and **Guaranteed**.

   Selected quotas are allowed to be assigned for the particular organization, while unselected ones are not allowed.

3) Select the quotas to make available for the Organization and unselect the ones not needed.

If a particular type of quota has already been assigned to an Organization, it cannot be unselected for that Organization.

1.1.8 Organization management by Domain user

One of the Domain User's responsibilities is managing the Domain Organizations. The Domain User is responsible for registering new Organizations in the system, assigning Datacenters to them, activating them, managing their Catalogs and Quotas.

1.1.8.1 Registering the Organization

The Domain User can register a new Organization in the system, indicating whether it is contract ID or contact data, with this function.

Follow these steps to register a new Organization as a Domain User.

1) Left-click **Management** and select **Organization Management**.

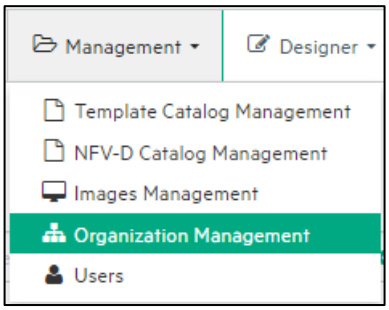


Figure 13: Organization Management option

This will display all the Organizations in the Domain.

Figure 14: Organization Management - Organizations table

2) Click **Actions** and select **Create Organization**.

Figure 15: Create Organization action

This will display a window where you can enter the Organization data.

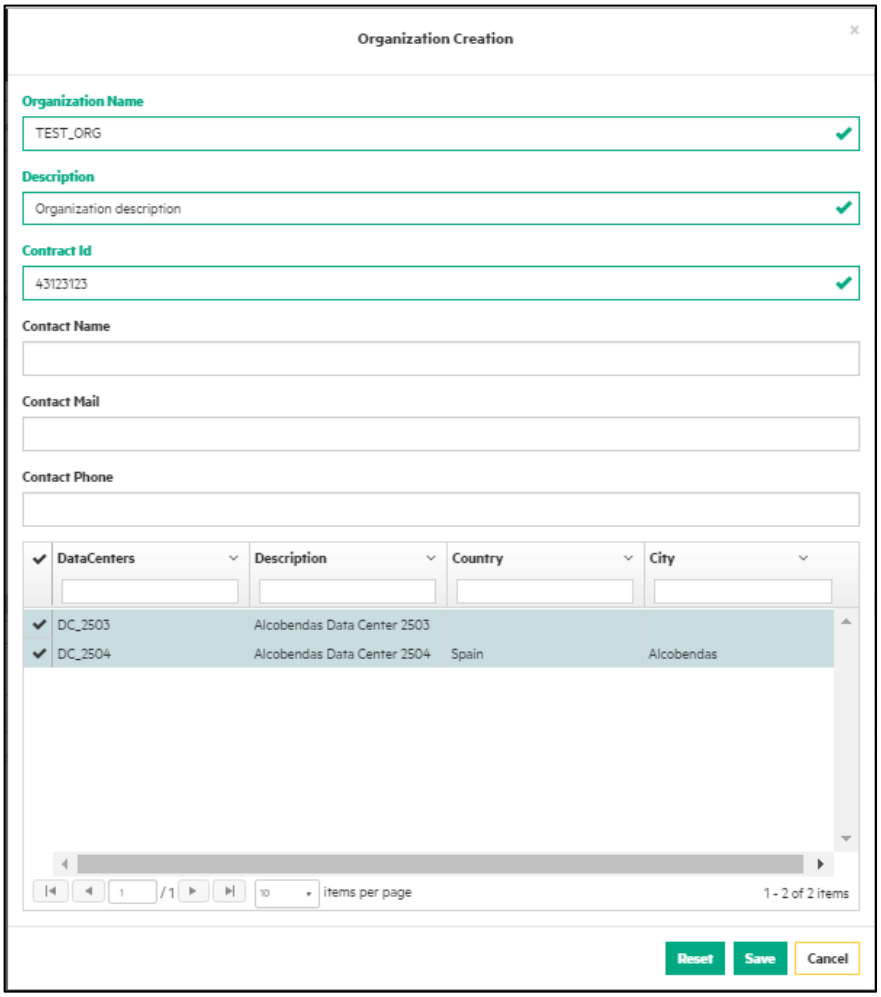


Figure 16: Organization Creation form

3) Enter the following Organization data:
   - **Organization Name**: It represents the Organization in the Domain. This name has to be unique for all Organizations.
   - **Description**: Text describing the new organization.

- **Contract Id**
- **Organization Contact information**: The contact name, mailing address, and phone number.
- **Organization DataCenters**.

1.1.8.2 Activating the Organization

Follow these steps to activate an Organization:

1) Select the Organization to activate, left-click **Actions** and select **Deploy Organization**.

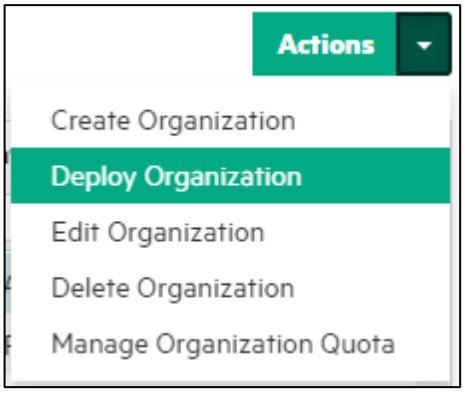


Figure 17: Deploy Organization action

This will display a confirmation window.

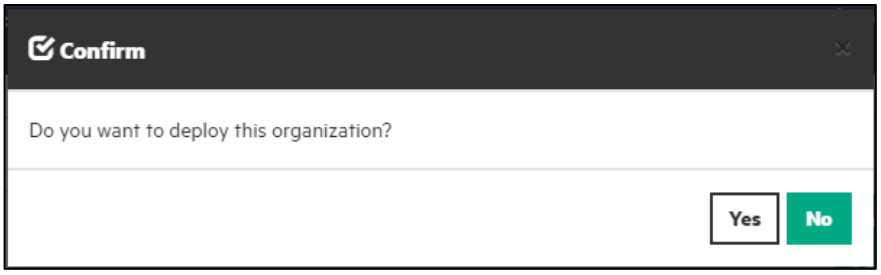


Figure 18: Organization Deployment - Confirmation Window

Once the activation has been launched, a message is displayed in the notification area and the corresponding job in the **Jobs Monitor**.

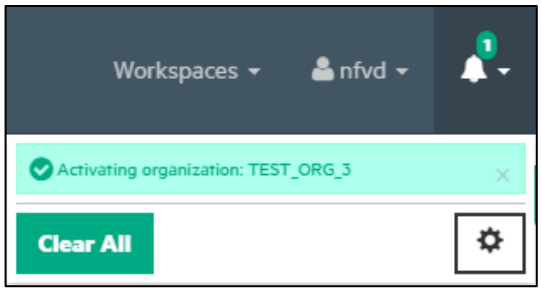


Figure 19: Activating Organization confirmation message in the notification area

Figure 20: Activating Organization message in the Jobs Monitor

You can follow the activation job progress in the **Job Tracking Screen** by clicking the **deployOrganization** link in the **Jobs Monitor**.

2) Wait until the activation job is finished and a message is displayed in the notification area.

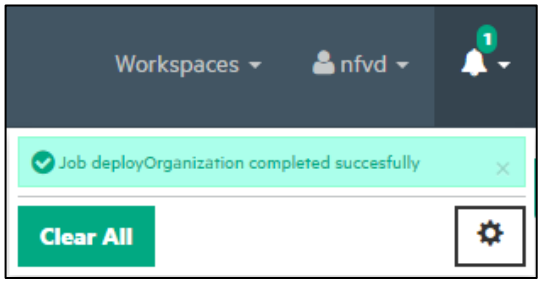


Figure 21: Organization Activation completed message in the notification area

The job status changes to **OK** in the **Jobs Monitor**.

Figure 22: Organization Activation completed message in the Jobs Monitor

Once the job is completed, the Organization status changes from **INSTANTIATED** to **ACTIVE** after a table refresh.

1.1.8.3 Editing an Organization

Follow these steps to edit an existing Organization:

1) Select the Organization, left-click **Actions** and select **Edit Info Organization**.

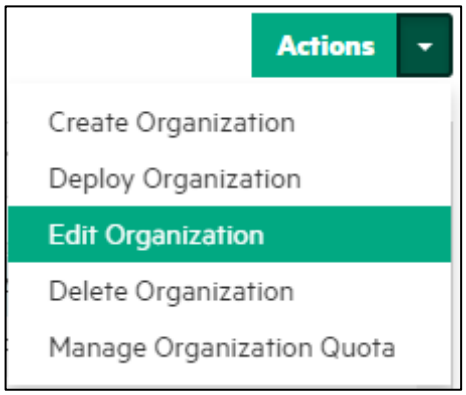


Figure 23: Edit Organization action

2) Edit the Organization data and click **Save**.

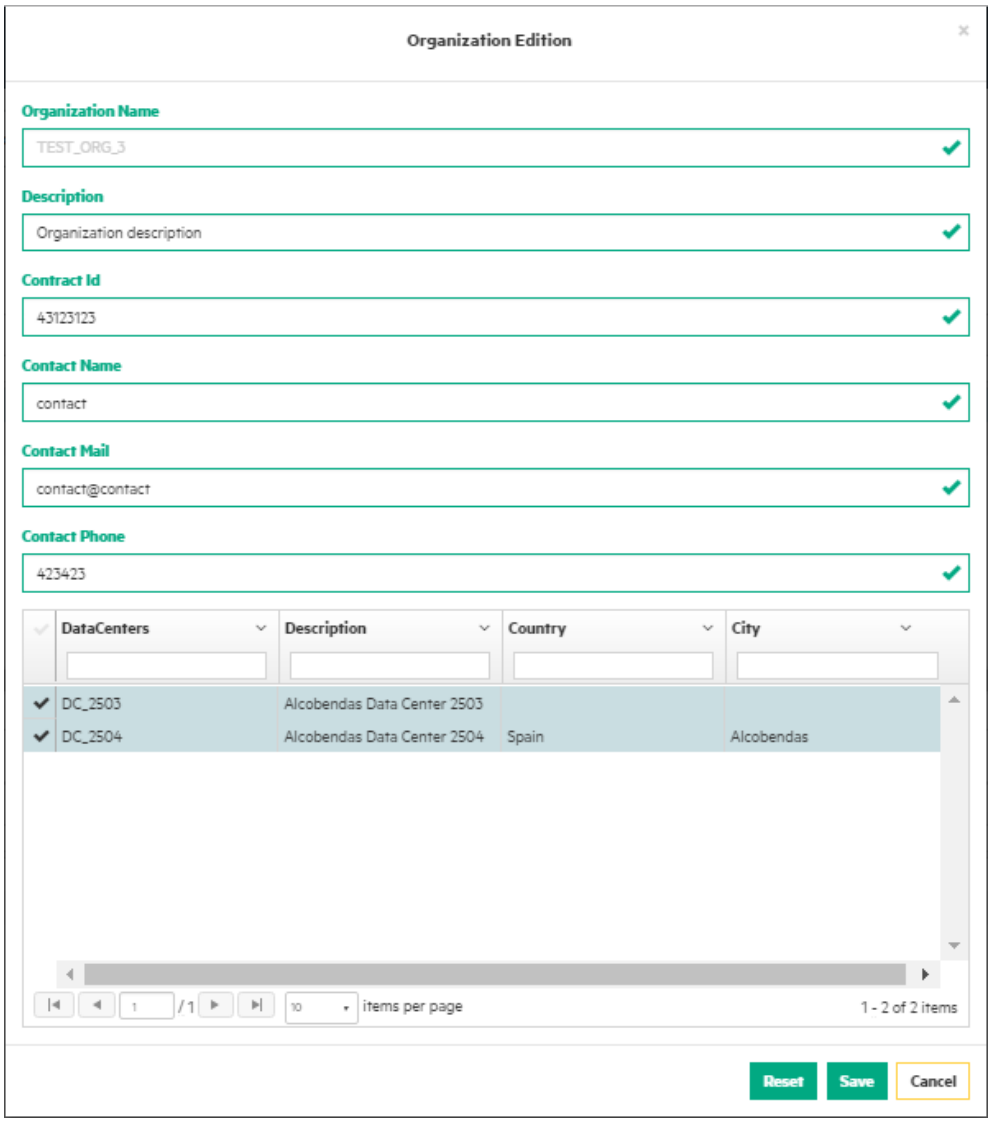


Figure 24: Organization Edit form

Organization Name cannot be changed and you can only attach new Datacenters to the Organization but not detach them.

Figure 25: Detaching Organization Datacenters error message

A confirmation window is displayed.

Figure 26: Organization Editing confirmation window

3) Click **Yes** in the confirmation window.

A confirmation message is displayed in the notification area after the Organization has been updated.

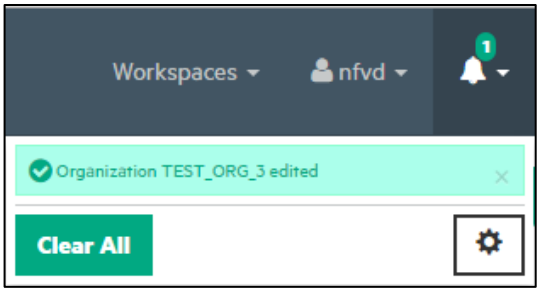


Figure 27: Organization edited confirmation message in notification area

1.1.8.4 Deleting the Organization

Only Organizations without ACTIVE VDC can be deleted. Otherwise, this option will not be available.

Follow these steps to delete an Organization:

1) Select the Organization to delete, left-click **Actions** and select **Delete Organization**.

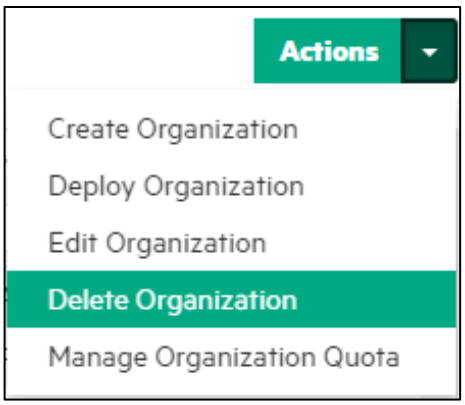


Figure 28: Delete Organization action

A confirmation window is displayed.

Figure 29: Organization Deleting confirmation window

2) Click **Yes** in the confirmation window.

Once the activation has been launched, a message is displayed in the notification area (the bell icon at top right) and the corresponding job in the **Jobs Monitor**.

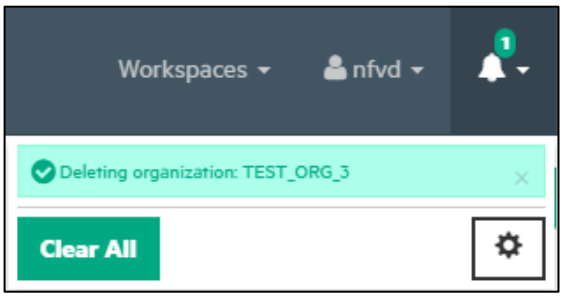


Figure 30: Deleting organization message in notification area

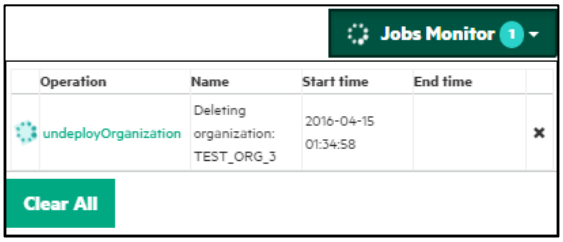


Figure 31: Deleting organization message in the Jobs Monitor

You can follow the activation job progress in the **Job Tracking Screen** by clicking on the **undeployOrganization** link in the Jobs Monitor.

3) Wait until the delete job completes and a message appears in the notification area..

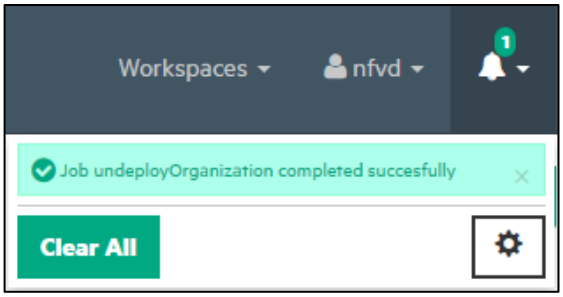


Figure 32: Deleting organization completed message in notification area

The job status changes to **OK** in the **Jobs Monitor**.

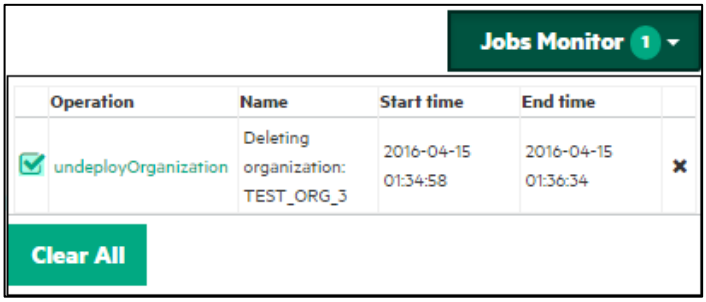


Figure 33: Deleting organization completed message in the Jobs Monitor

1.2 Datacenter Level

1.2.1 Datacenter Entity

The Datacenter Entity represents a physical datacenter.

Datacenter is the physical facility used to house computer systems and associated components, such as storage systems and networking infrastructure. It includes the entire physical infrastructure:

- power supplies
- data communications connections
- environmental controls (cooling, fire suppression)
- a number of security items.

Datacenters also include their own management infrastructures.

1.2.2 Datacenter Users

A Datacenter User is intended to manage a specific Datacenter of the domain. It can be registered by a Domain User or another Datacenter User.

Currently a Datacenter User can only manage a datacenter, so Datacenter information must be specified when the user is created from the NFVD Portal.

The following table includes the profiles and operations available for a Domain User:

Table 3: Datacenter User Profiles and Operations

Profile	Operations
Administrator	Manage Datacenter Users

Monitoring	

1.2.3 Datacenter Resources

The resources available in a Datacenter are determined by its infrastructure: all available servers and infrastructure that can be used for virtualizing, and will be used for VNF deployments.

A Domain User can view the resources in all Datacenters, but Datacenter User can only view the resources of its own Datacenter.

Follow these steps as a Datacenter User to view your Datacenter servers:

1) Click **Summary** in the top bar.

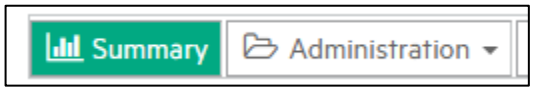


Figure 34: Datacenter Summary option in the top bar

2) Click the drop-down list to display a Server list.

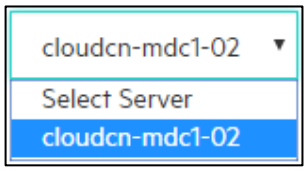


Figure 35: Select Server drop-down list

A window with a list of all the servers in the Datacenter is displayed.

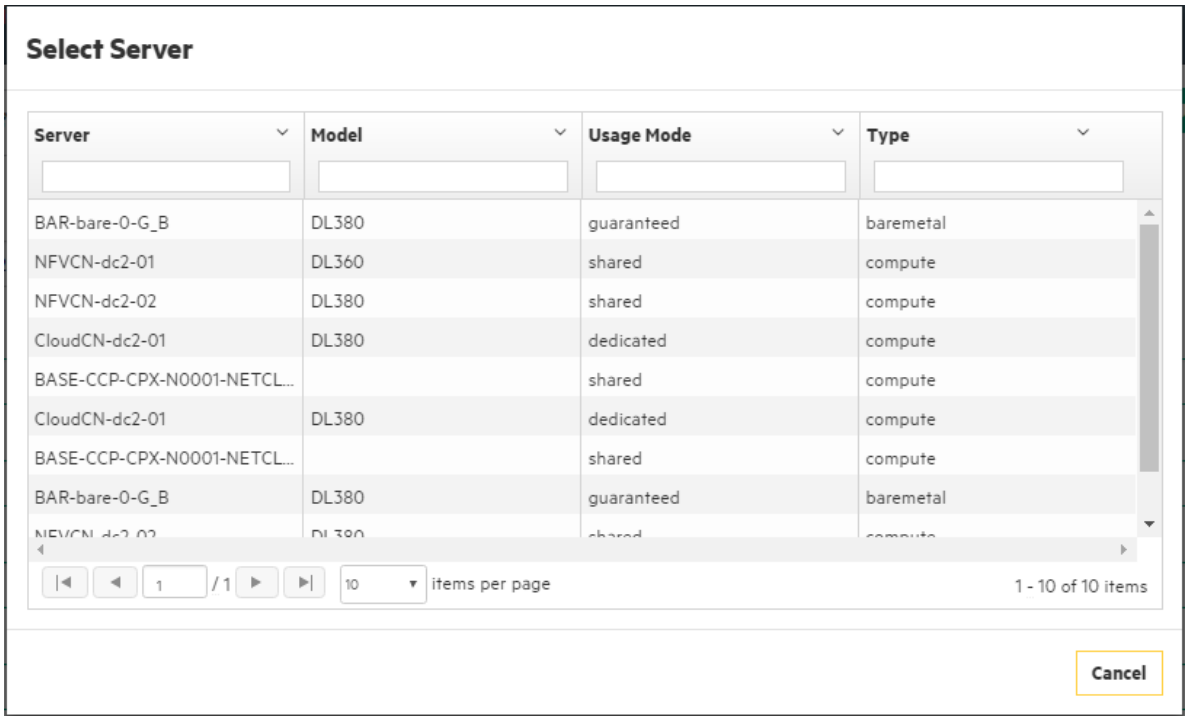


Figure 36: Select Datacenter Server window

Select the server and left-click **Cancel** to display additional server information.

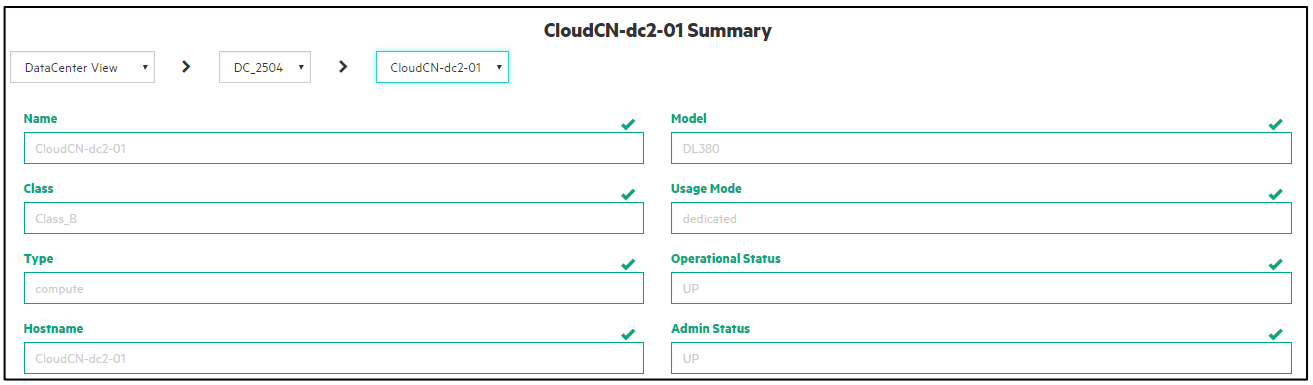


Figure 37: Datacenter Server Details

1.3 Organization level

1.3.1 Organization Entity

An Organization represents a particular company or contract in the Domain. An Organization Entity includes all the virtual infrastructure in the Domain within the particular Organization.

The organization entity will be registered in the system by a Domain User through “Organization Management” functionality.

1.3.2 Organization Users

An Organization User manages a specific Organization in the Domain. It can be registered by a Domain User or another Organization User.

Currently this user type can only manage an organization, so the organization must be specified when the user is created from the NFVD Portal. Refer to the User Registration section for additional information.

When an Organization User creates another one, it can only assign its own organization.

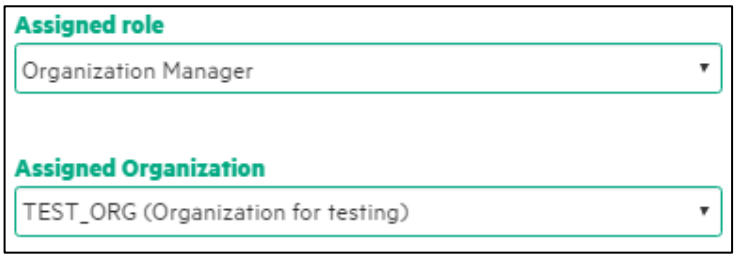


Figure 38: Assigning Organization to Organization User

The following table includes all the profiles and operations available for a Domain User.

Table 4: Organization User Profiles and Operations

Profile	Operations
Administrator	Manage Organization Users Manage VDC Users Manage VNF Group Users
Provisioning	Grant/Revoke VDC Images Manage VDC Manage VNF Groups View Jobs Manage Jobs Manage Networks Manage Organization Catalog Manage Organization Images Manage Organization Template Catalog Manage VDC Template Catalog Manage VNF Group Template Catalog Check VDCs Quota View VDC Manager Check VNF Group Quota Manage VDC Images Grant/Revoke VNF Group Images Manage Firewalls Manage Load-Balancers Manage VNFs Manage Monitors Manage Storage Manage VNF Group Images
Template Designer	Manage VNF Group Templates Manage VDC Templates
Monitoring	

1.3.3 Organization Resources

An Organization can only use available resources in its associated Datacenters. An Organization can use resources from one or more Datacenters (depending on the Organization contract). Those Datacenters are assigned to the Organization by a Domain User during registration.

You can assign a new Datacenter to a Group by editing it, but you cannot remove one from it. Refer to the Organization Edition section for additional information.

The guaranteed quotas that can be assigned to an Organization are restricted to resources that are available in its Datacenters.

1.3.4 Organization Quota

The Organization Quota determines the quantity of resources that can be used in that Organization for deploying VNFs. The Domain and Organization Users can manage the Organization Quota.

This functionality lets you assign a Domain Resource quota to the Organization. The Organization Quota will be restricted to those Domain Datacenters that were assigned to the Organization.

The resource types you can assign to an Organization is also restricted to its Private Catalog. Refer to the NFV-D Catalog section for additional information.

1.3.4.1 Organization Quota Management by Domain User

Follow these steps as a Domain User to change the Organization Quota.

1) Left-click **Management** and select **Organization Management**.

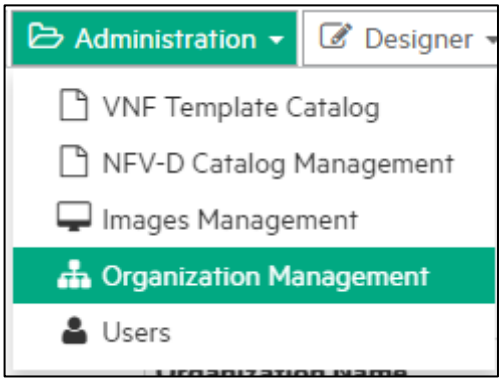


Figure 39: Organization Management option

2) In the window indicating the available Organizations, left-click **Actions** and select **Manage Organization Quota**.

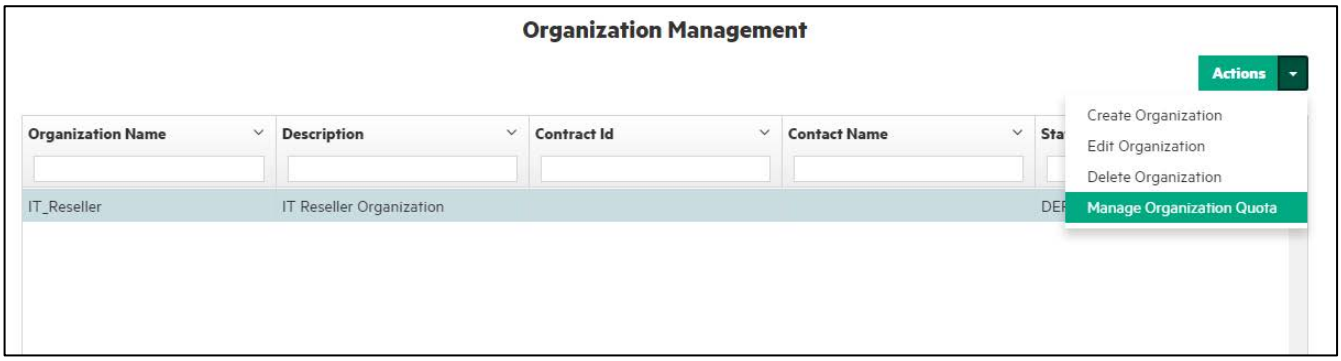


Figure 40: Manage Organization Quotas action

The **Organization Quota Management** screen is displayed where you can assign a quota on Domain resources to that Organization.

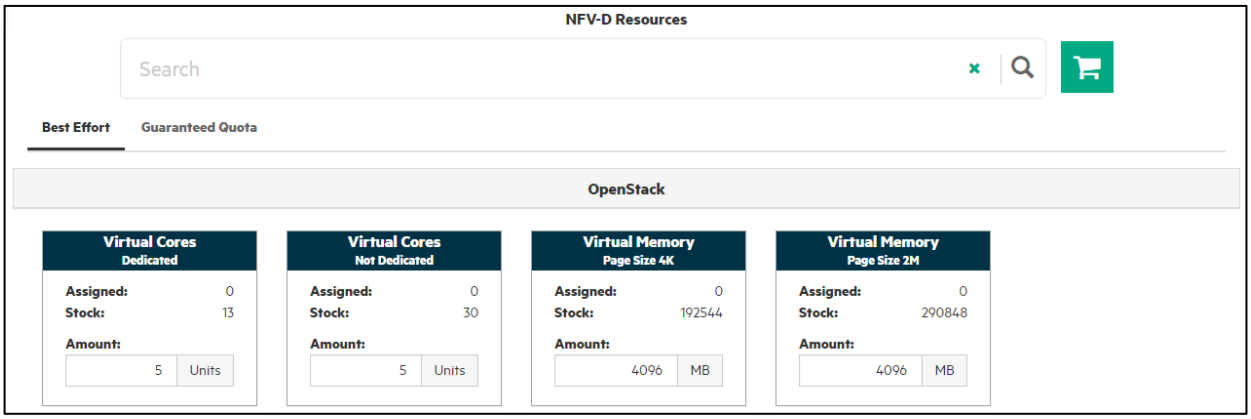


Figure 41: Organization Quota Management

1.3.4.2 Organization Resource Inventory (Quota Summary)

Organization Users can access a summary of all Organization Quotas filtered by VDC or VNF Group.

Click **Resource Inventory** as an Organization User to access your Organization Quota.

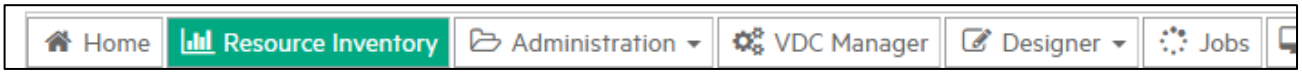


Figure 42: Resource Inventory option

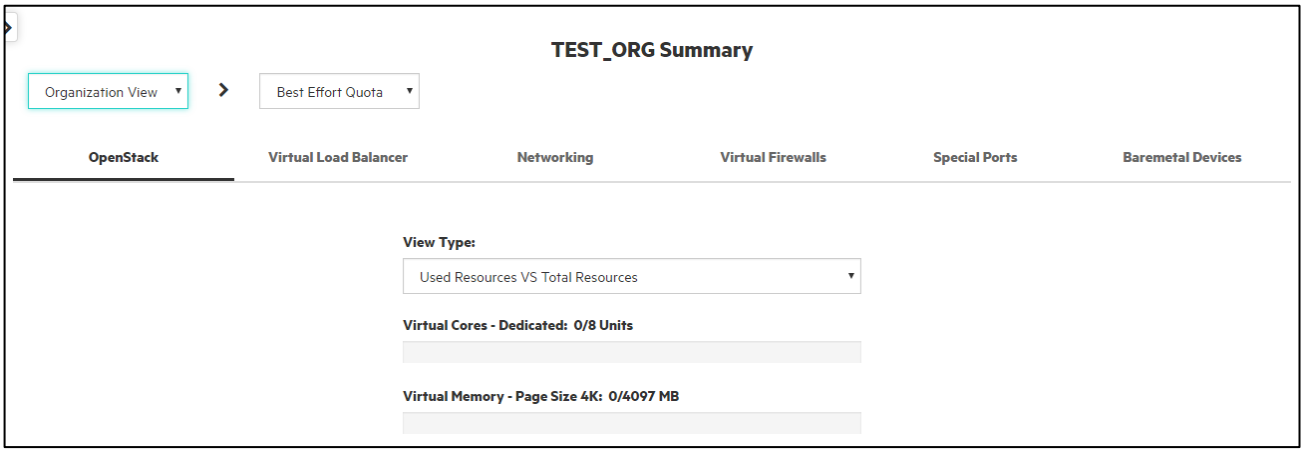


Figure 43: Quota Summary

One of three Quota views can be selected in the drop-down list.

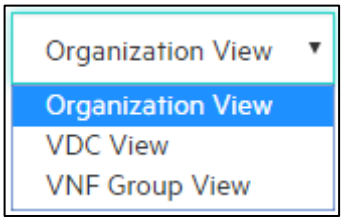


Figure 44: Organization Summary Views

- **Organization View**: It displays all Organization Quota.

  Clicking on the left icon (magnifying glass) for a resource displays a graph indicating its availability and the consumption by VDC.

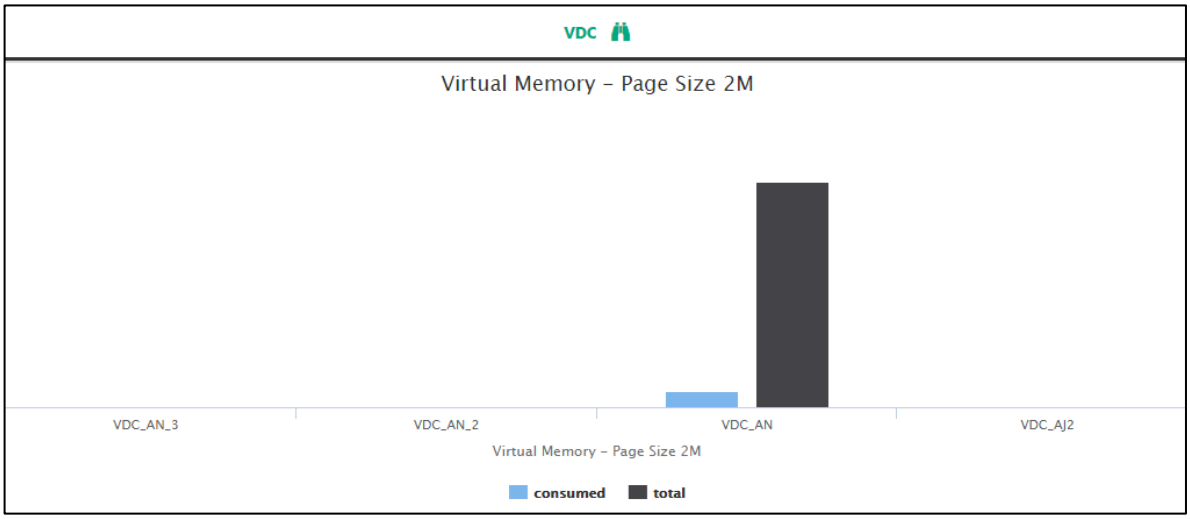


Figure 45: Virtual Memory – Page Size 2M graph

- **VDC View**: This displays the Organization Quota by its VDCs.

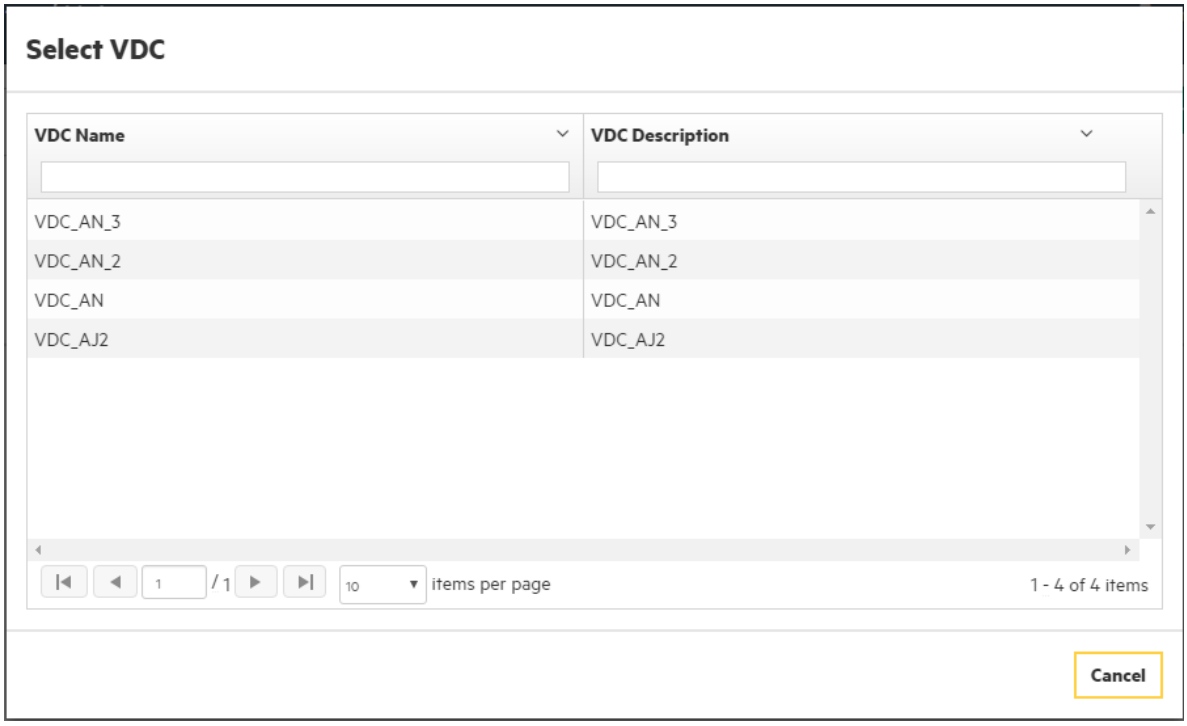


Figure 46: Organization VDC selection

Selecting a VDC displays its Quota Summary:

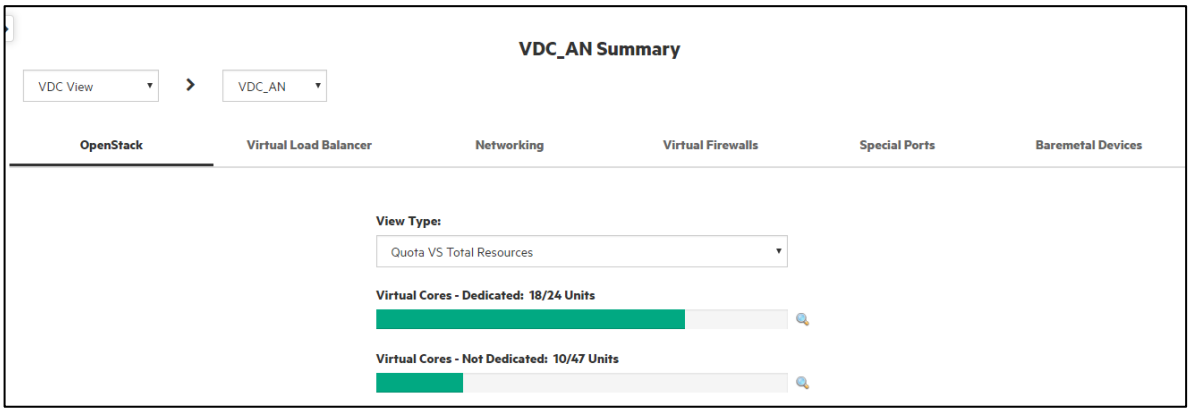


Figure 47: VDC Quota View

Left-click the second drop-down list to select another VDC.

Figure 48: VDC Section drop-down list

This displays the **VDC selection** window again.

- **VNF Group View**: This displays the **Organization Quota** by its VNF Groups.

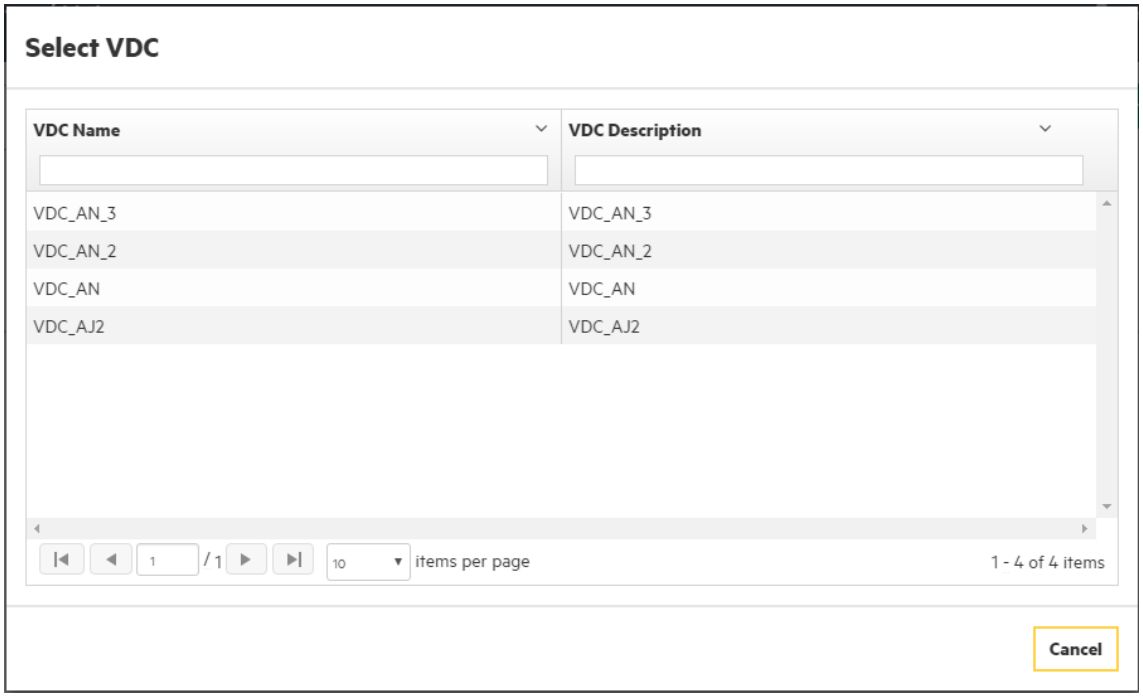


Figure 49: Organization VDC selection

After selecting a VDC, one of its VNF_GROUPs must be selected in the next window:

Figure 50: Organization VNF Group selection

This displays the VNF Group Quota Summary.

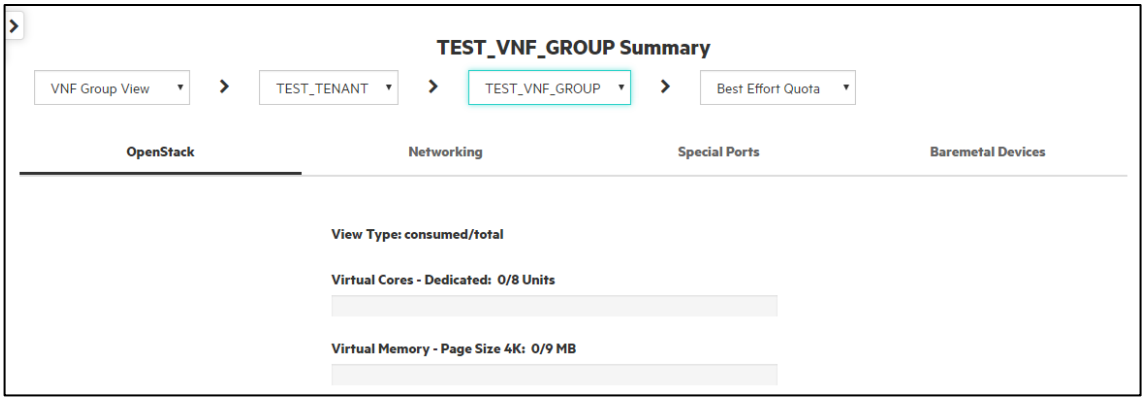


Figure 51: VNF Group Quota Summary

Click the second drop-down list to open the VDC selection window.

Figure 52: VDC selection drop-down list

Click the third drop-down list to display the VNF_GROUP selection window and select another VNF Group.

Figure 53: VNF Group selection combo box

1.3.4.3 Organization Quota Quick View

If you are logged in as an Organization User, you can click the **Next** icon (always available at the left side of the screen) to display a Quick View of all consumed/assigned Organization Quota:

Figure 54: Organization Quota – Quick View icon

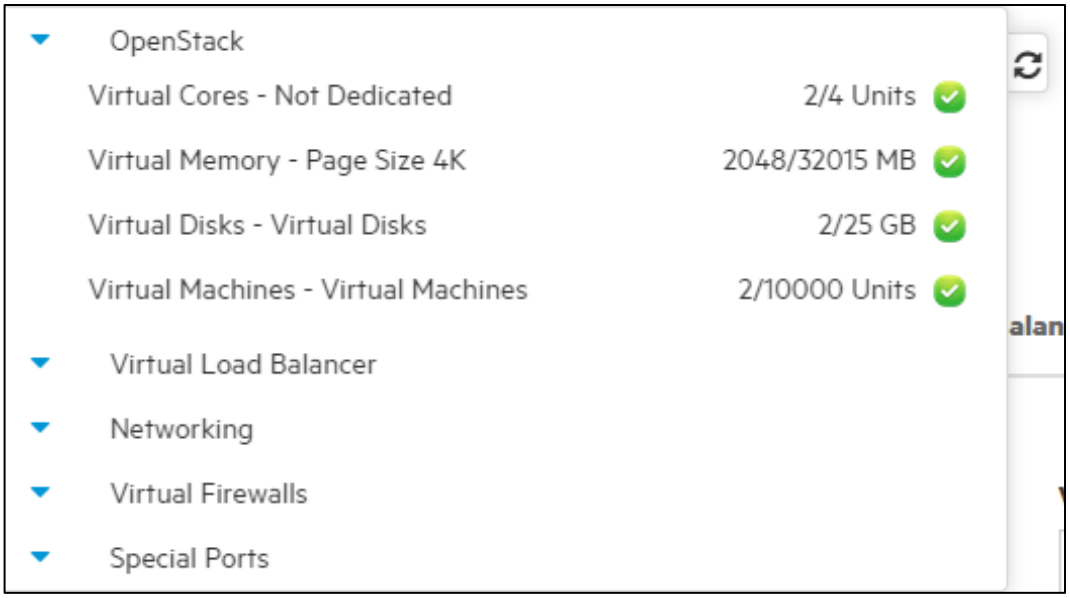


Figure 55: Organization Quota - Quick View Navigation

Click the **Refresh** icon to refresh the Quota information:

Figure 56: Organization Quota – Quick View Refresh icon

Figure 57: Organization Quota – Quick View Refreshing

1.3.5 Organization Catalog

The Organization Catalog is the set of all the available templates in the Organization. There are two different types of Organization Templates:

- VDC Templates: Used to create VDCs in the Organization.
- VNF Templates: Assigned to the Organization VDCs to deploy the VNFs.

A Domain User can add templates to an Organization (or remove them from it) if those templates are available in the Domain Catalog.

An Organization User can create its own VNF templates from the Portal using the **VNF Component Designer** and the **VNF Designer**. The VNF Templates created and published from those designers will be available in the Organization Catalog of that user.

1.3.5.1 Organization Catalog Management

Only a Domain User can manage an Organization Catalog.

Two types of templates can be assigned to an organization: VDC and VNF templates.

- A VDC template is a particular template built to represent a resource infrastructure.

- A VNF template represents the design of a VNF and it will be the base piece used to create VNF instances.

Follow these steps to manage an Organization Catalog as a Domain User:

1) Left-click **Management** and select **VNF Template Management** to display a table of all Organizations.

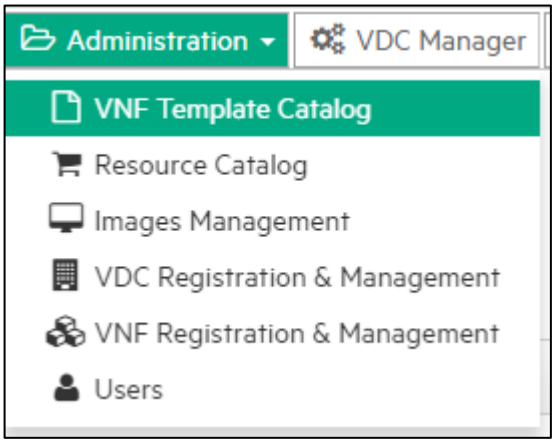


Figure 58: VNF Template Management option

2) Select an organization and left-click **Assign VDC Templates** or **Assign VNF Templates** depending on the type of template you are going to add to or remove from the Organization.

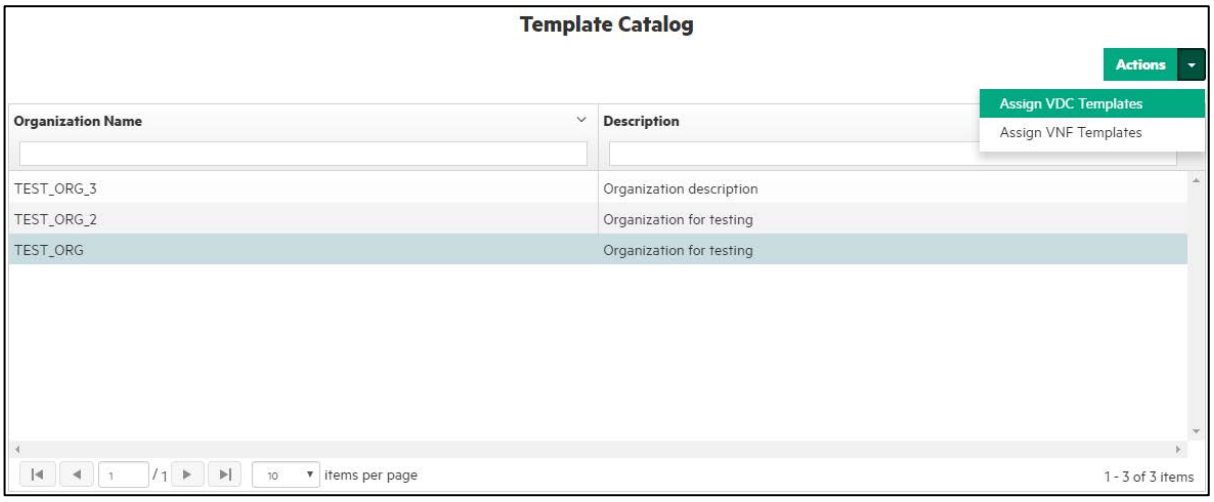


Figure 59: Assign VDC Templates action

3) Select the Templates to include in the Organization Catalog and click **Save**.

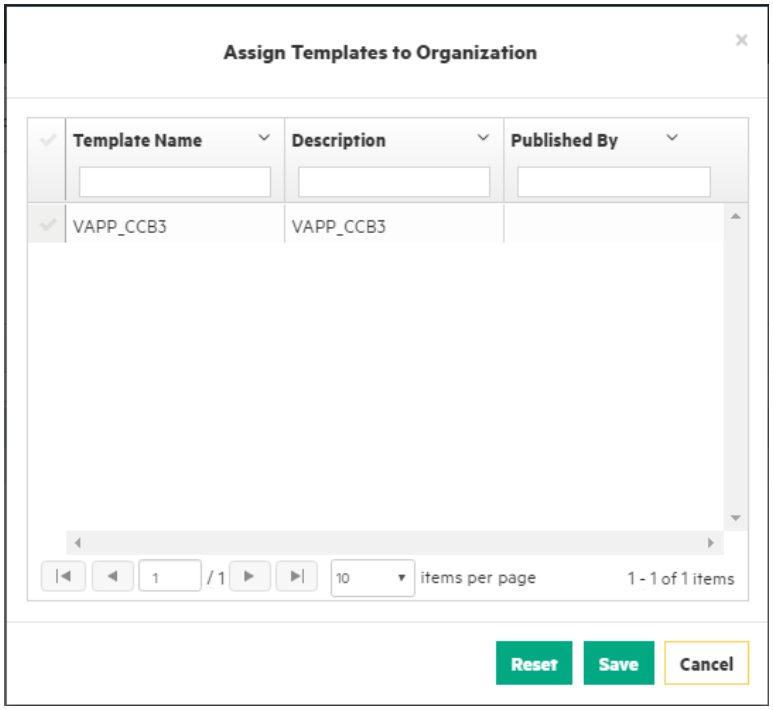


Figure 60: Assign Templates to Organization

1.3.6 Organization Image repository

The Organization Image repository contains all the Operative Systems Images, which can be deployed in a specific Organization. An Organization User can register and upload an Image from the **NFVD Portal** and make it public (accessible to other users) or private.

Refer to the NFV Director Images Management chapter for additional information on Image Management.

1.3.7 Organization VDC Management

One of an Organization User's responsibilities is managing its Organization VDCs:

- registering new VDCs in the system
- activating VDCs
- assigning Datacenters to registered VDCs
- managing VDC Catalog and Quota

1.3.7.1 Registering a VDC

Follow these steps to register a VDC as an Organization User.

1) Left-click **Management** and select **VDC Registration & Management** to display all the VDCs in the Organization.

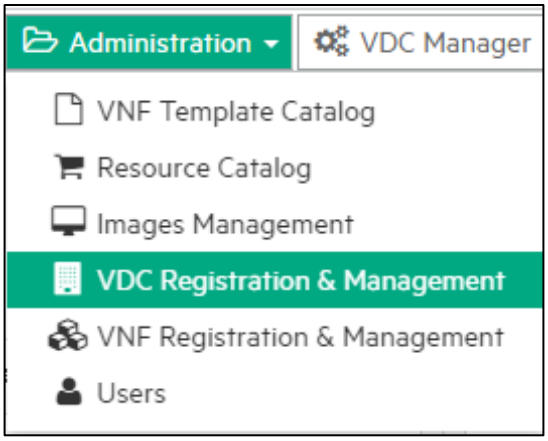


Figure 61: VDC Registration & Management option

2) Left-click **Actions** and select **Create VDC** to display all the VDC Templates available in the Organization Catalog.

Figure 62: Create VDC action

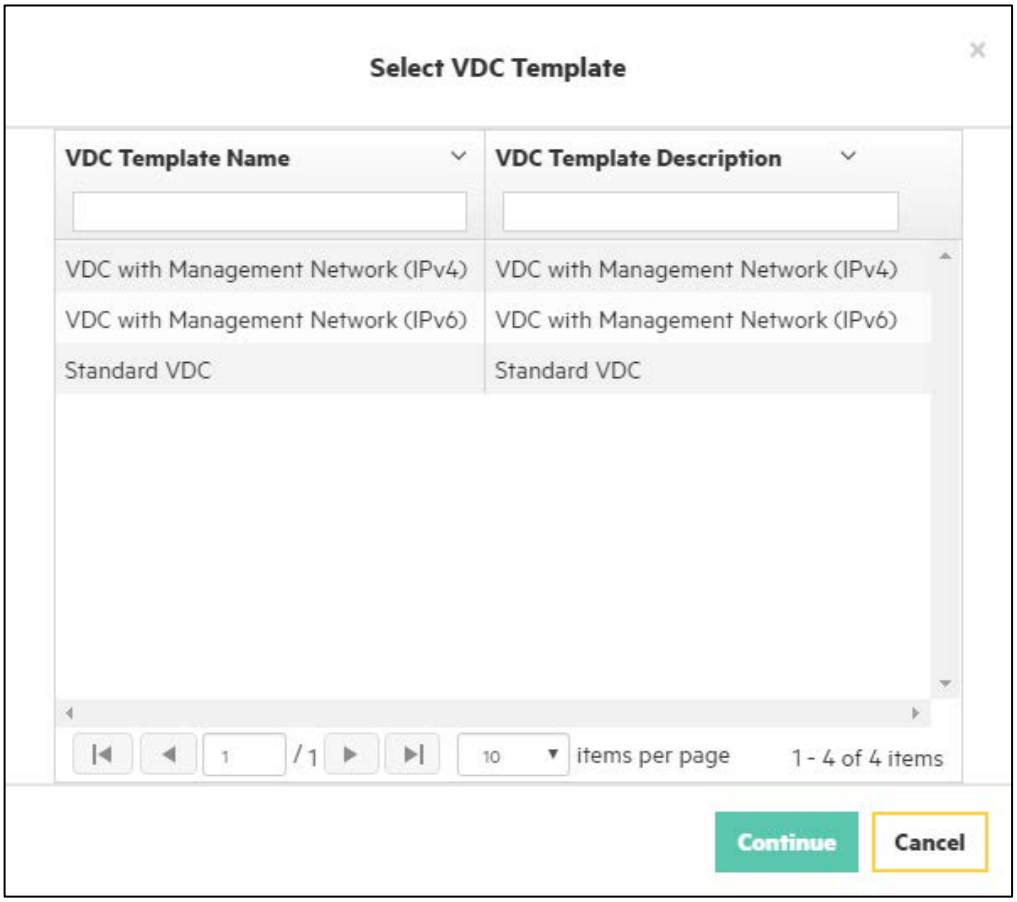


Figure 63: VDC Template selection

You have three possibilities:

- **Standard VDC**: This option represents a Virtual DataCenter (or VDC) standard. In this case the VDC will not create a network during the deployment, it only has quotas, users, resource pool, and catalog. This represents the base component of a VDC.
- **VDC with Management Network (IPv4)**: This VDC will create, in addition, an external network and a management network. The IP address of the subnetwork in the management network will be in version 4 (for example, with mask: 10.0.0.0/24). It will be really useful on multisite environments.
- **VDC with Management Network (IPv6)**: This VDC will be similar to **VDC with Management Network (IPv4)**, but subnetwork's IP address will be version 6 (for example, with mask: 2001:0db8:0a0b:12f0:0000:0000:0000:0001/64). It will be really useful on multisite environments.

NOTE: The management networks are deployed with a subnetwork but they are not displayed in the **VDC Manager**, because this network is for internal use and the user must not modify any network properties.

3) Select a VDC Template and click **Continue**.

   It is not possible to register a new VDC without a Template, so a Template has to be selected from the list. This will display a new modal window for entering VDC data.

4) Enter the required VDC data:
   - **VDC Name**: A name that represents the VDC in the system. It has to be unique for all VDCs in the NFVD.
   - **VDC Description**: A description for the new VDC.
   - **VDC Datacenters**: The VDC quota is restricted to the resources available in its associated Datacenters. A VDC cannot use resources from an unassociated Datacenter.

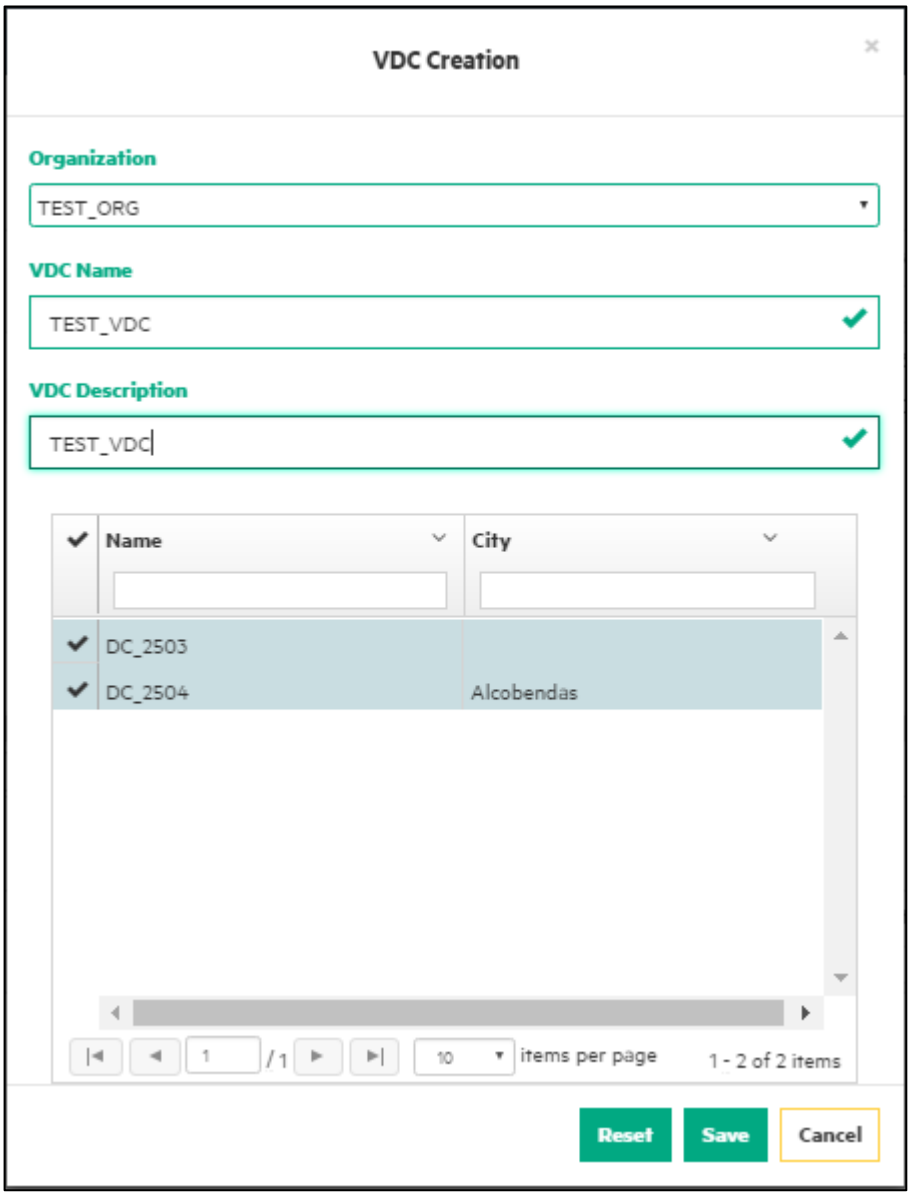


Figure 64: VDC Creation form

A message is displayed in the notification area after the new VDC has been registered.

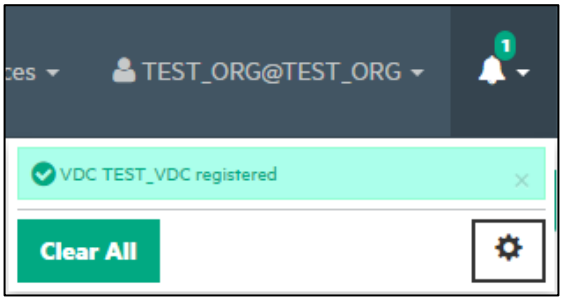


Figure 65: VDC registered confirmation message in the notification area

An error message is displayed in the notification area if the VDC has not been created due to an error.

A VDC can have two statuses:

- **INSTANTIATED**: This is the status of a VDC after it has been registered and before it has been activated.
- **ACTIVE**: This is the status of an appropriately activated VDC.

1.3.7.2 Activating a VDC

Follow these steps to activate a VDC.

1) Select the VDC to deploy, left-click **Actions**, and select **Deploy VDC**.

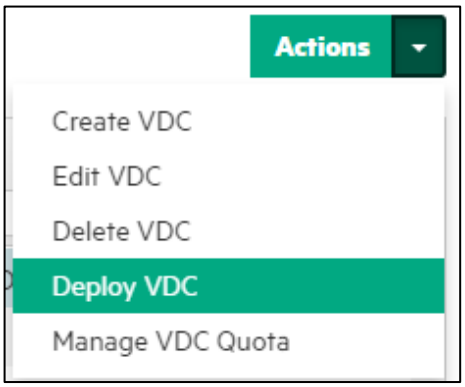


Figure 66: Activate VDC action

A message is displayed in the notification area and in the **Jobs Monitor** after the activation has been launched.

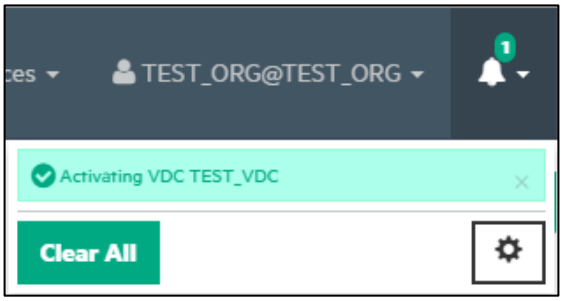


Figure 67: VDC activation message in the notification area

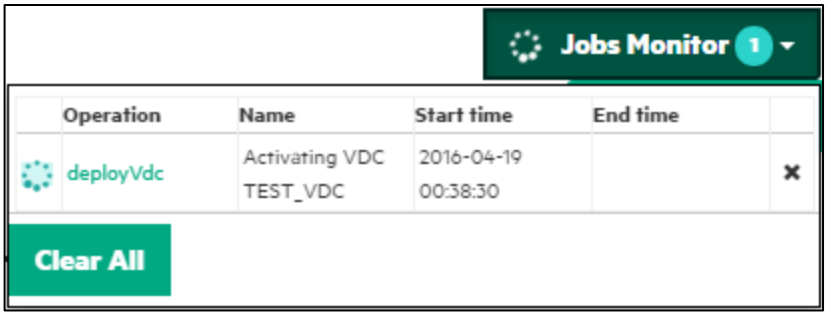


Figure 68: VDC activation message in the Jobs Monitor

You can follow the activation job progress on the **Job Tracking Screen** by clicking the **deployVdc** link in the **Jobs Monitor**.

2) A message is displayed in the notification area and the job status is changed to **OK** in the **Jobs Monitor** after the activation job has completed.

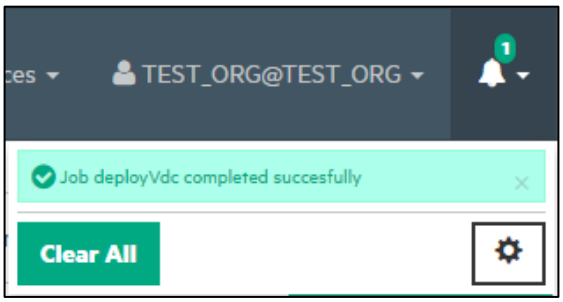


Figure 69: Successful VDC activation message in the notification area

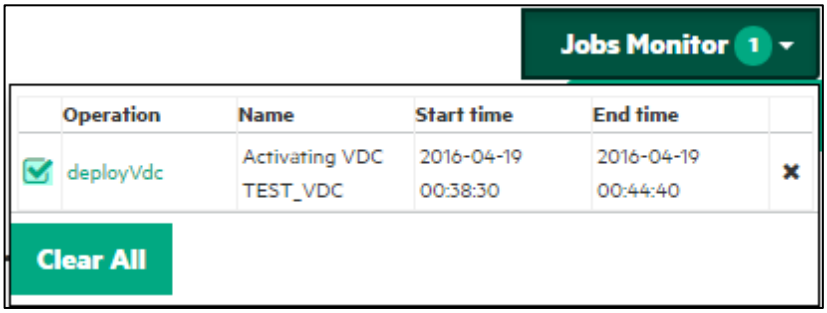


Figure 70: Job status in the Jobs Monitor

The VDC status is changed from **INSTANTIATED** to **ACTIVE** after the job has completed. Refresh the table to see the changes.

1.3.7.3 Editing a VDC

Only the **Description** field can be updated in the VDC, **Name** and **Datacenters** cannot be changed.

Follow these steps to edit an existing VDC.

1) Select the VDC, left-click **Actions** and select **Edit VDC**.

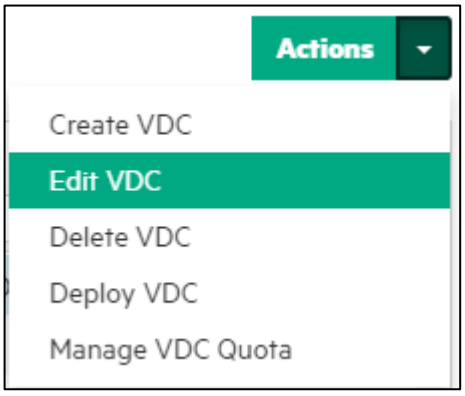


Figure 71: Edit VDC action

2) Edit the VDC description and click **Save**.

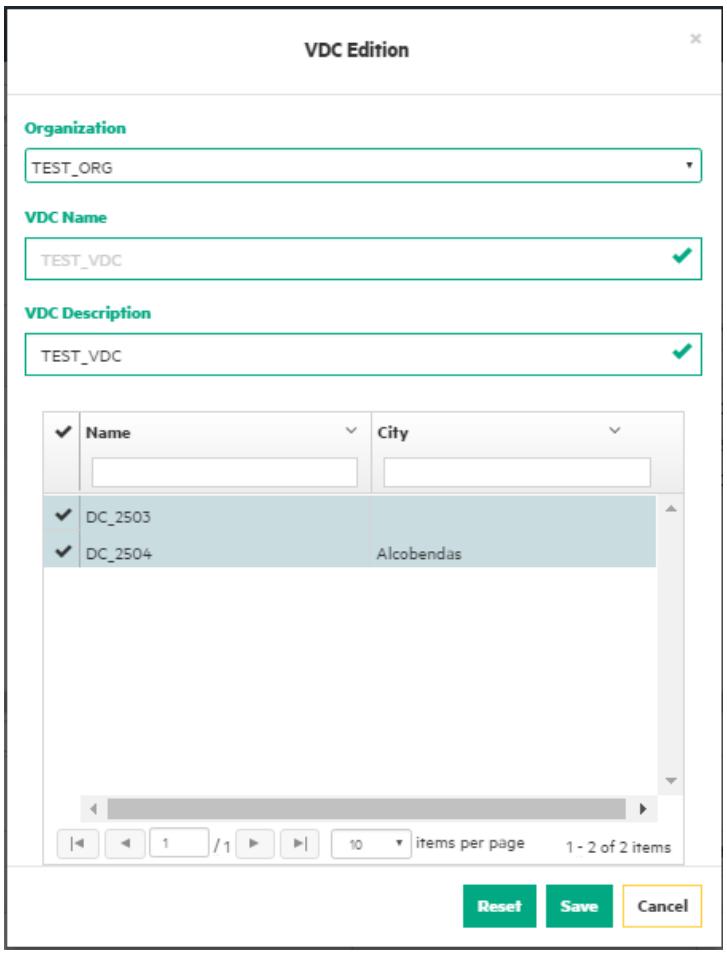


Figure 72: VDC editing form

A confirmation window is displayed.

Figure 73: VDC editing confirmation window

3) Click **Yes** in the confirmation window to display a confirmation message in the notification are after the VDC description has been updated.

Figure 74: VDC edited confirmation message in the notification area

1.3.7.4 Deleting a VDC

Only **VDCs** with no VNF Group, Virtual Link, or VNF status can be deleted. Otherwise, this option will not be available.

Follow these steps to delete a VDC.

1) Select the VDC to delete, left-click **Actions** and **Delete VDC**.

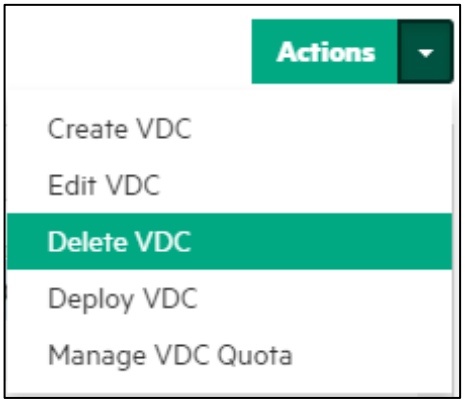


Figure 75: Delete VDC option

A confirmation window is displayed.

Figure 76: Confirmation window - Delete VDC

2) Click **Yes** in the confirmation window to display a confirmation message in the notification area and in the **Jobs Monitor**.

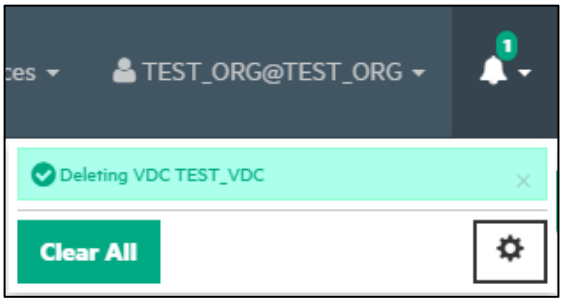


Figure 77: Delete confirmation VDC message in the notification area

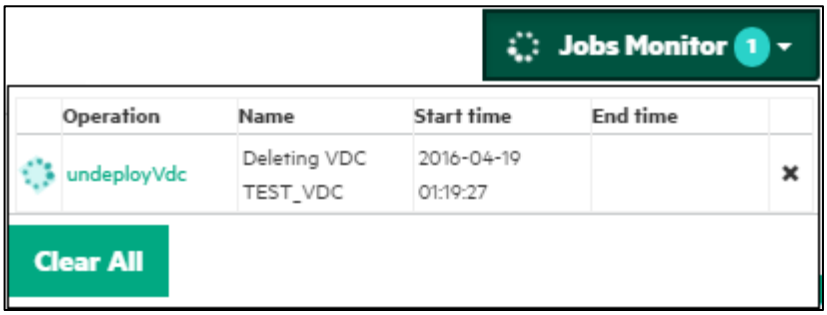


Figure 78: Delete VDC message in the Jobs Monitor

You can follow the activation job progress on the **Job Tracking Screen** by clicking the **undeployVdc** link in the **Jobs Monitor**.

3) A message is displayed in the notification area and the job status is changed to **OK** in the **Jobs Monitor** after the delete job is completed.

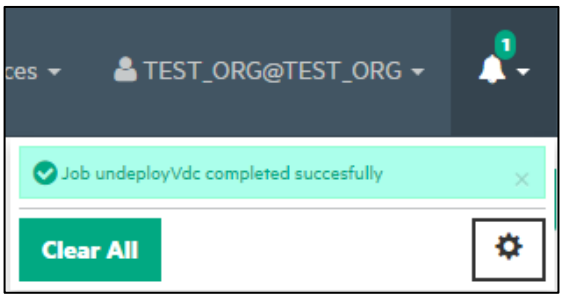


Figure 79: VDC delete completed message in the notification area

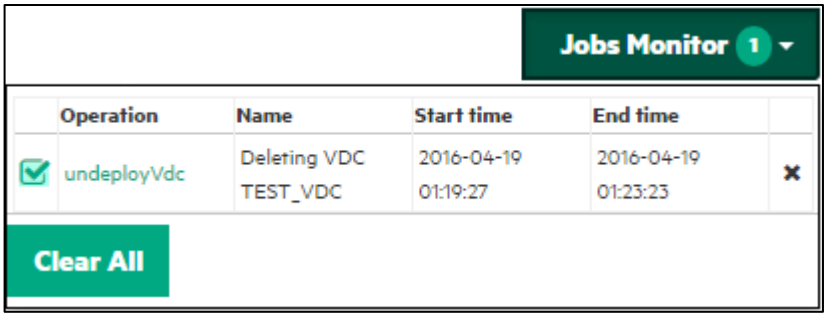


Figure 80: VDC delete completed message in the Jobs Monitor

1.4 VDC Level

1.4.1 VDC Entity

A VDC is a virtual infrastructure with several types of virtualized resources. It is where the VNF can be deployed. A VDC belongs to only one Organization (VDCs are not shared between Organizations) and it should be registered and activated by an Organization User using the **VDC Management** functionality.

1.4.2 VDC Users

A VDC User is intended to manage a specific VDC in a Domain Organization. It can be registered by a Domain User, an Organization User, or another VDC User.

Currently this kind of user can manage an only VDC, so specify the VDC is mandatory when the user is created from the NFVD Portal.

When a VDC User creates another one, it can only assign its own VDC. If the VDC User is created by an Organization User, it is only possible to assign it a VDC of the user's organization.

The following table indicates the profiles and operations available for a VDC User.

Table 5: VDC User Profiles and Operations

Profile	Operations
Administrator	Manage VDC Users Manage VNF Group Users
Provisioning	Grant/Revoke VNF Group Images Manage VNF Groups Manage Firewalls Manage Jobs Manage Load-Balancers Manage Networks Manage VDC Images Manage VDC Template Catalog Manage VNFs Manage VNF Group Template Catalog Check VDCs Quota View VDC Manager Check VNF Groups Quotas View Jobs Manage Monitors Manage Storage

	Manage VNF Group Images
Template Designer	Manage VNF Group Templates Manage VDC Templates
Monitoring	

1.4.3 VDC resources

A VDC can only use the available resources in its Datacenters. The resources will be used to deploy VNFs in that specific VDC.

When a VDC is registered by an Organization User its associated Datacenters have to be indicated. You can assign a new Datacenter to a VNF Group by edition but not remove it.

The guaranteed quotas that can be assigned to a VDC are restricted to those resources that are available in its Datacenters.

1.4.4 VDC Quota

The VDC quota determines the quantity of resources that can be used in that VDC for deploying VNFs. Only an Organization User can manage VDC quota.

Follow these step to manage VDC Quote as an Organization User:

1) Left-click **Administration** and select **VDC Registration & Management** to display all the VDCs in the Organization.

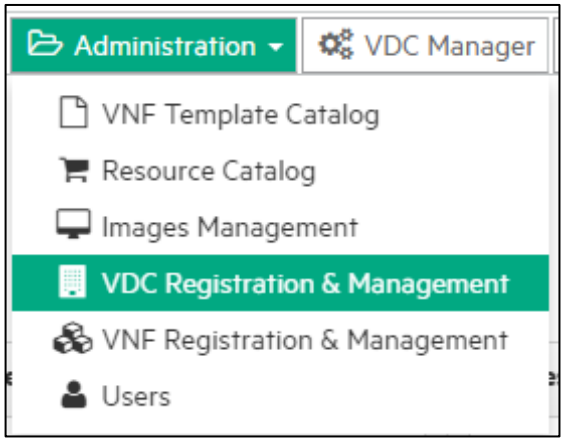


Figure 81: VDC Registration & Management option

2) Select the VDC, left-click **Actions** and select **Manage VDC Quota** to display the **VDC Quota Assignment** screen.

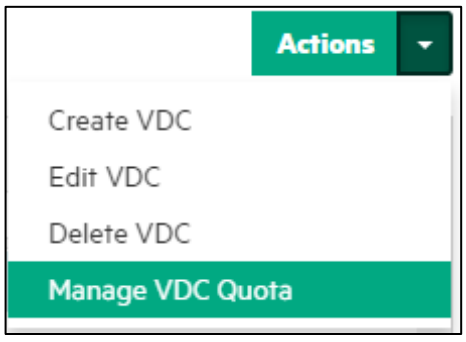


Figure 82: Manage VDC Quota action

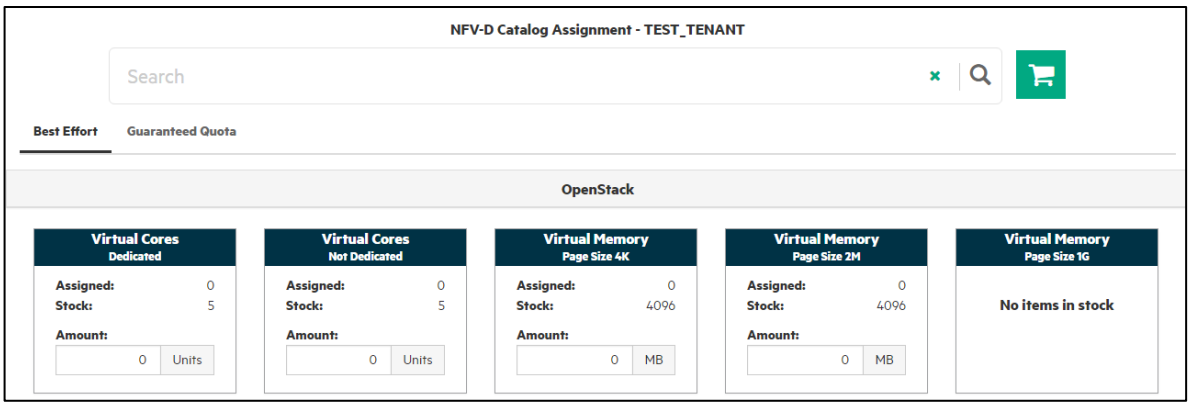


Figure 83: VDC Quota Assignment

The quota that an Organization can assign to a VDC is restricted by its own Organization Quota. Refer to *Organization Quota* for additional information.

1.4.4.1 VDC Resource Inventory (Quota Summary)

VDC Users can access a summary of all of their VDC Quotas, filtering them by VNF Group.

Click on the Resource Inventory option as a VDC User to access your VDC Quota.

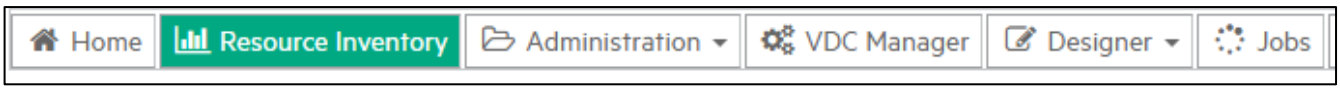


Figure 84: Summary option

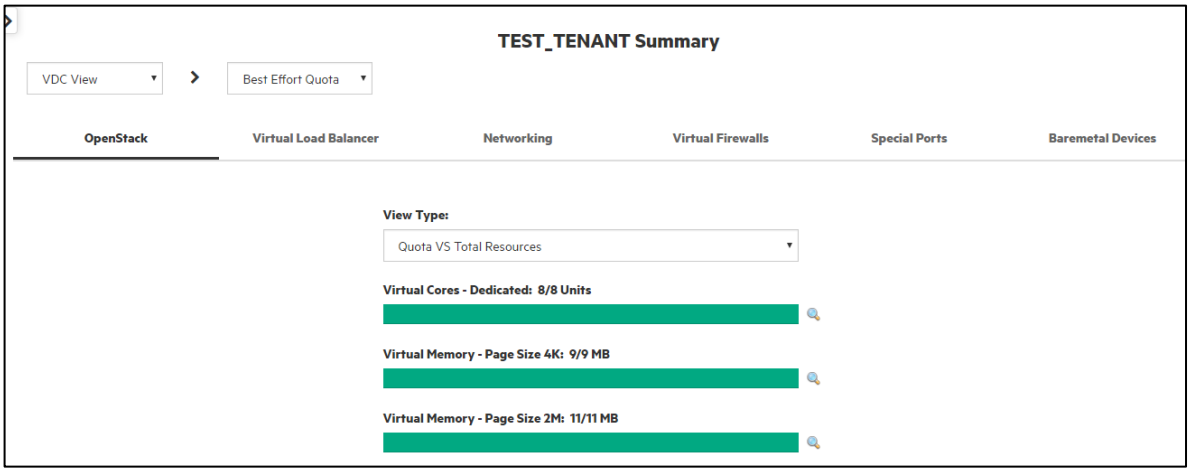


Figure 85: VDC Summary screen

You can access two quota views with the VDC View drop-down list:

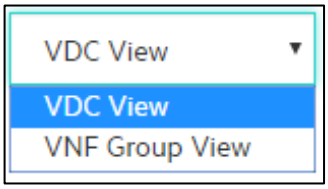


Figure 86: VDC Summary Views

- **VDC View**: Displays all VDC Quota. Click the magnifying glass icon to the left of a resource, displaying its availability and VDC consumption.

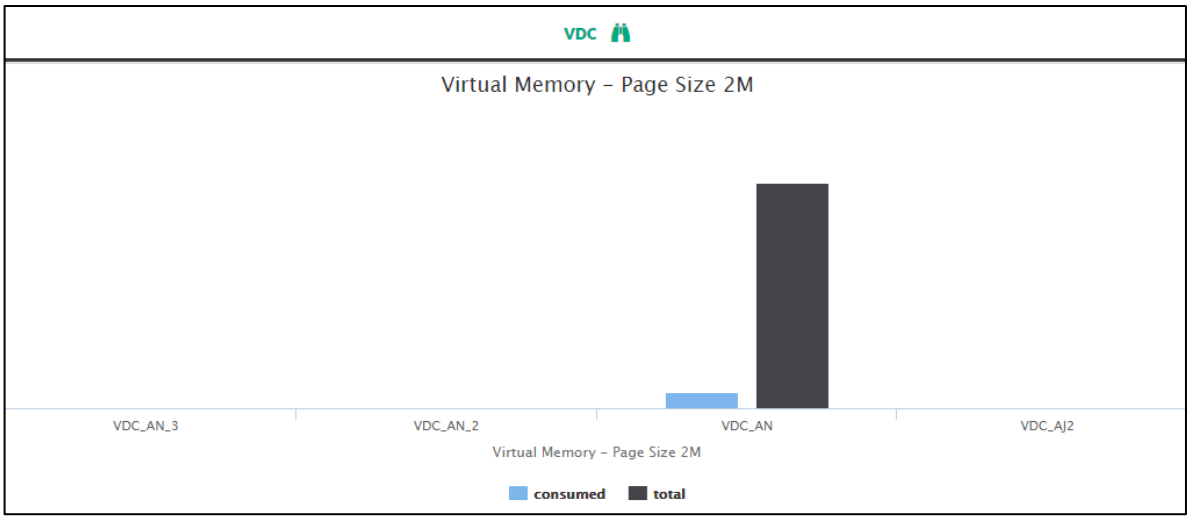


Figure 87: Virtual Memory - Page Size 2M graph

- **VNF Group View**: Displays VDC Quota by VNF Groups. A list of all VDC VNF_GROUPs is displayed after selecting **VNF View** in the drop-down list.

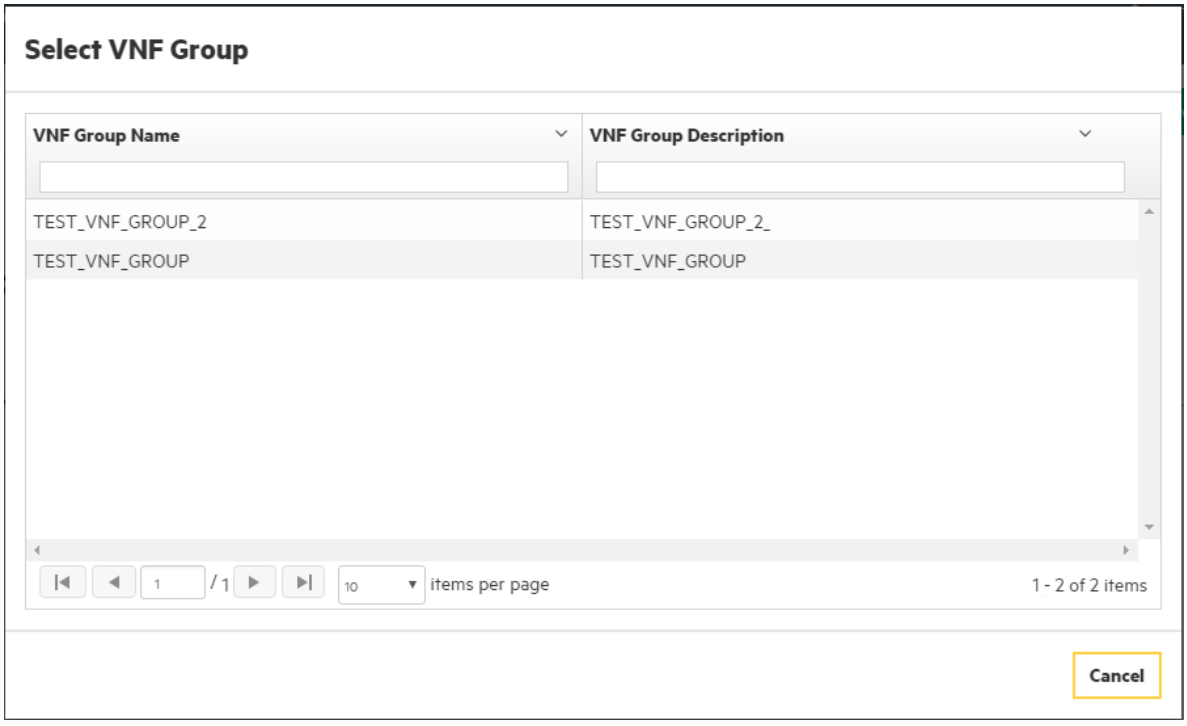


Figure 88: Organization VNF Group selection

Selecting a VNF GROUP displays its Quota Summary.

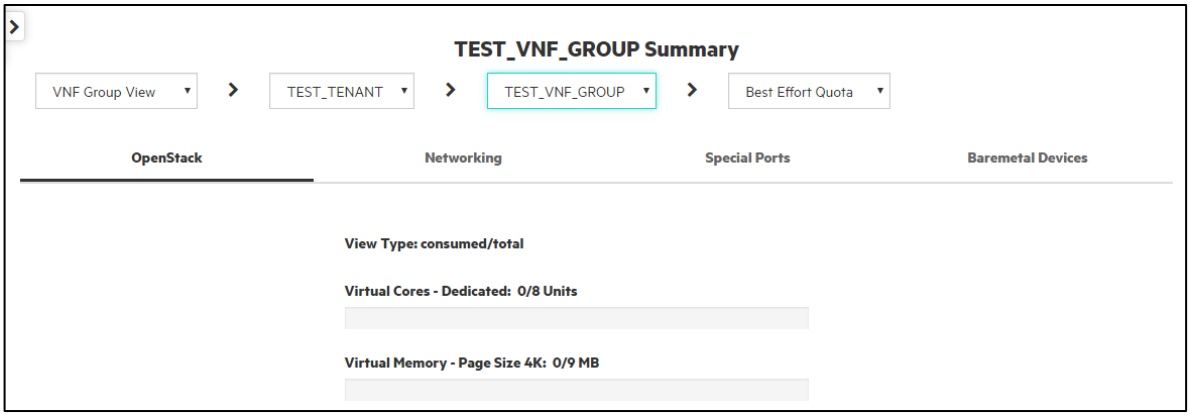


Figure 89: VNF GROUP Quota Summary

Use the second drop-down list to select another VNF Group.

Figure 90: VNF Group selection drop-down list

1.4.4.2 VDC Quota Quick View

Click the **Quick View** icon, which is always available at the left side of the screen, as a VDC User to display a quick view of the quota consumption for every quota type.

Figure 91: VDC Quota Quick View icon

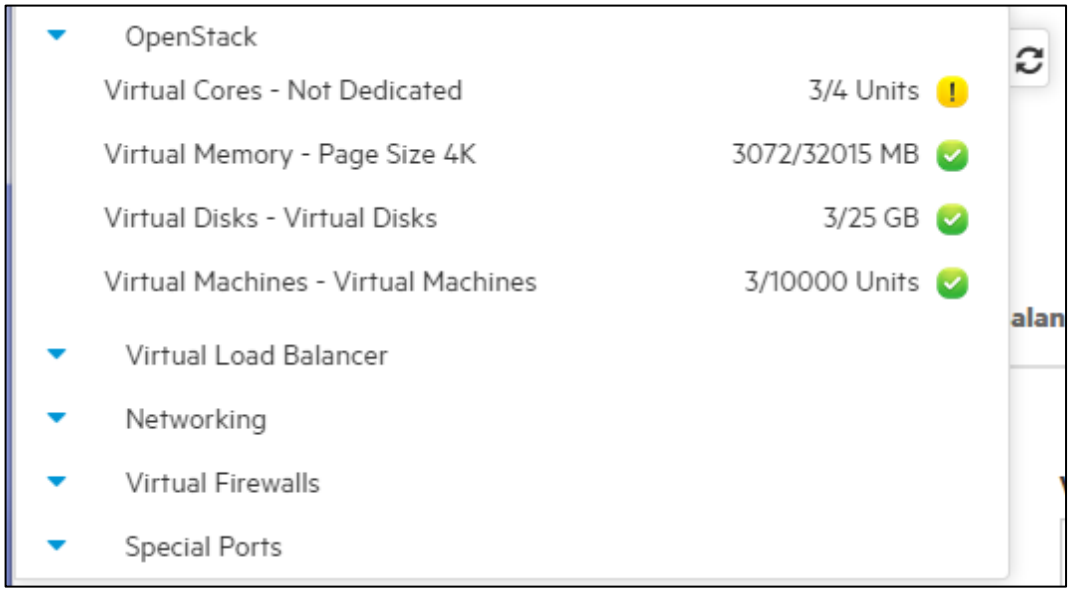


Figure 92: VDC Quota Quick View Navigation

Click the **Refresh** icon to refresh the Quota information.

Figure 93: VDC Quota - Quick View Refresh icon

Figure 94: VDC Quota Quick View refreshing

1.4.5 VDC Catalog

A VDC Catalog is a set of VNF Templates assigned to the VDC. Only an Organization User can manage a VDC Catalog.

Follow these steps to make changes in a VDC Catalog:

1) Left-click **Administration** and select **VNF Template Catalog** to display a list of all VDCs in a User's Organization.

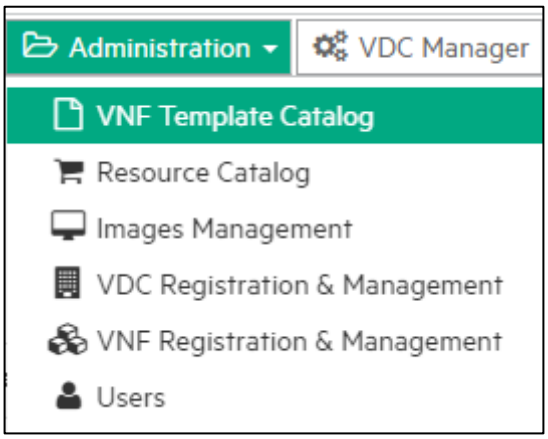


Figure 95: VNF Template Catalog

2) Select a VDC, left-click **Actions** and select **Assign Templates** to display all the VNF Templates assigned to the User's Organization.

Figure 96: Assign Templates action

3) Select all the templates to add to the VDC Catalog and unselect the ones to remove.

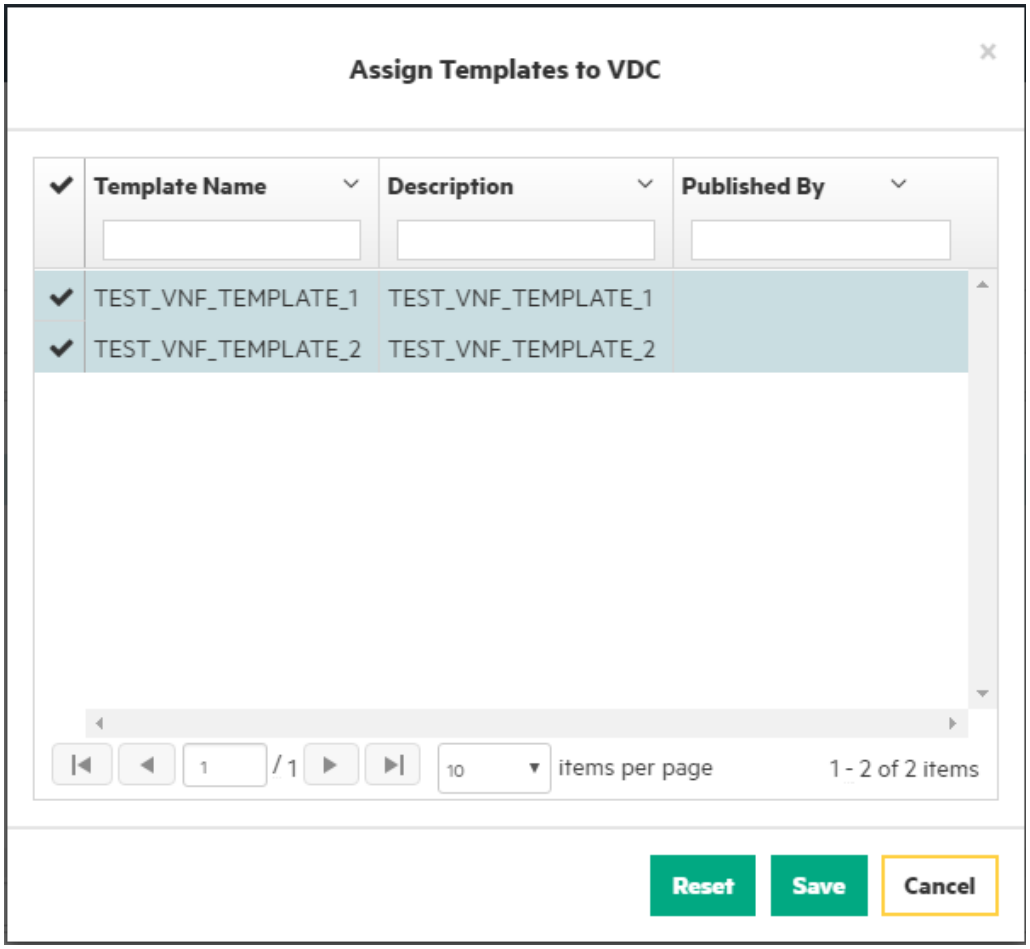


Figure 97: Assign Templates to the VDC

4) Click **Save** to save changes and refresh the table indicating the VNF Templates of the selected VDC.

Figure 98: VDC VNF Templates tables

1.4.6 VDC Image repository

The VDC Image repository contains all the Operative System Images that can be deployed in a specific VDC. A VDC User can register and upload an Image from the NFVD Portal and make it either public (accessible to other users) or private.

Refer to the NFV Director Images Management chapter for additional information on Image Management.

1.4.7 VDC VNF Group Management

A VDC User's responsibilities include managing VNF Groups:

- registering new VNF Groups in the system
- assigning and activating Datacenters
- managing the Catalog and its quota

An Organization User can carry out those functions too.

1.4.7.1 Registering a VNF Group

Follow these steps to register a VNF Group.

1) Left-click **Administration** and select **VNF Registration & Management** to display the **VNF Group Registration** screen.

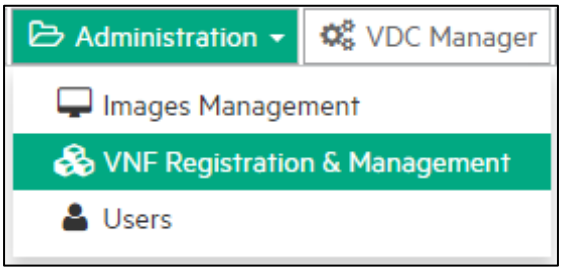


Figure 99: VNF Group Registration & Management option

2) Left-click **Actions** and select **Create VNF Group**.

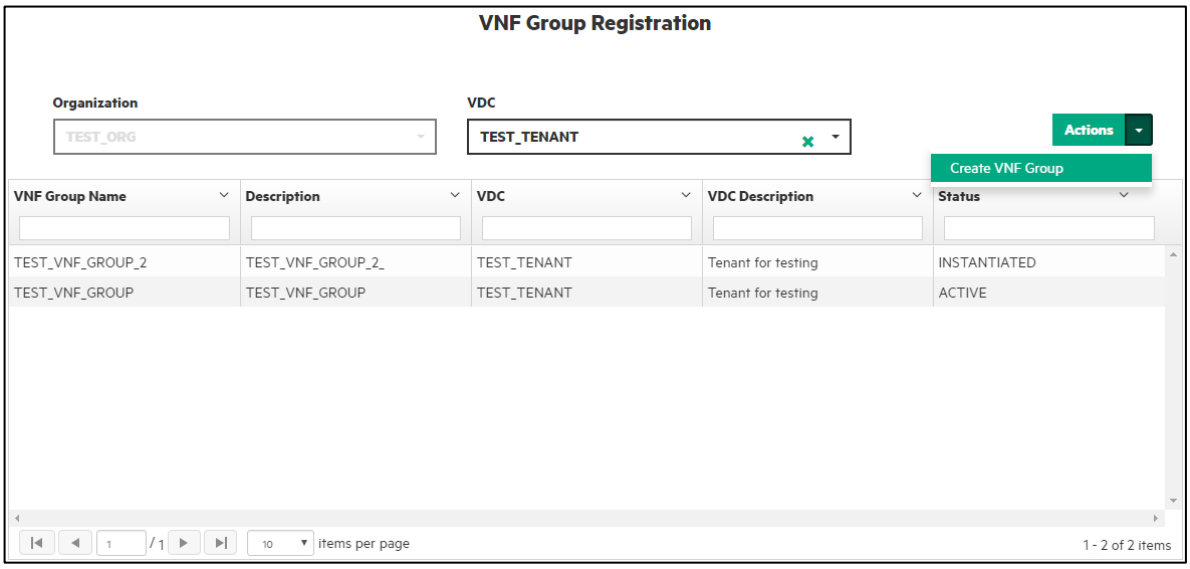


Figure 100: Create VNF Group action

A modal window is displayed to enter the new VNF Group information.

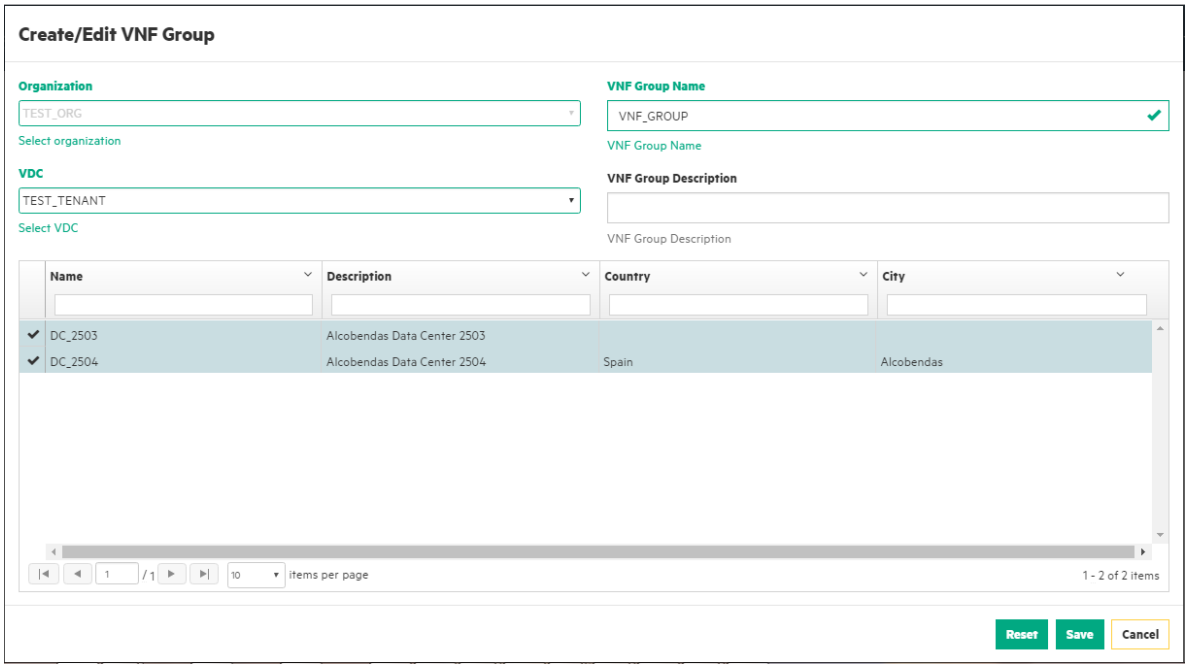


Figure 101: Create/Edit VNF Group

3) Enter the VNF Group information:
   - **VDC**: This is the logged in VDC User. If the logged in user is an Organization User, a VDC of user's Organization can be selected.
   - **VNF Group Name**: This unique name represents the VNF Group in the System.
   - **VNF Group Description**: This describes the VNF Group.
   - **VNF Group Datacenters**: The VDC Quota is restricted to the resources available in its associated Datacenters.
   - Click **Save**.

A message is displayed in the notification area indicating the success or failure of VNF Group creation.

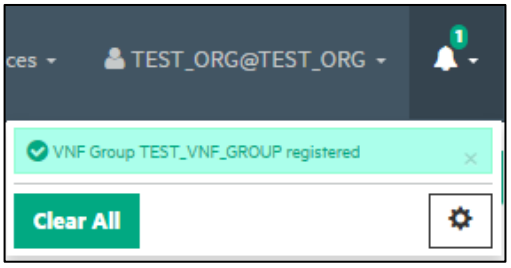


Figure 102: VNF Group creation feedback in the notification area

The VNF Group is registered with **INSTANTIATED** status.

1.4.7.2 Activating a VNF Group

Follow these steps to activate a VNF Group.

1) Select the VNF Group to deploy, left-click **Actions** and select **Deploy VNF Group**.

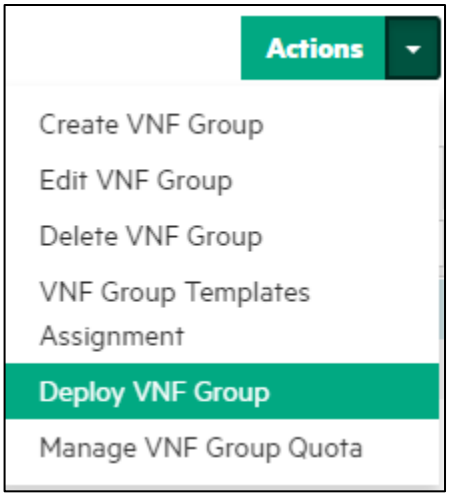


Figure 103: Deploy VNF Group action

After activation is complete, a message is displayed in the notification area and the **Jobs Monitor** indicates the corresponding job.

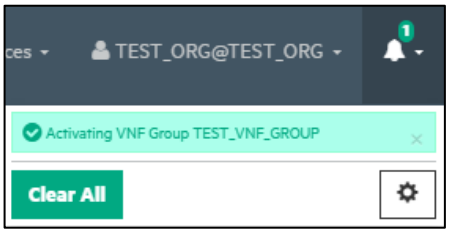


Figure 104: VNF Group activation feedback in the notification area

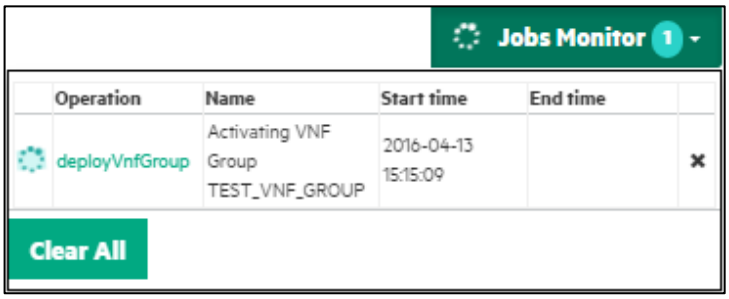


Figure 105: VNF Group activation feedback in the Jobs Monitor

Click the **deployVnfGroup** link in the **Jobs Monitor** to follow the activation job progress.

2) After the activation job is completed, a message is displayed in the notification area.

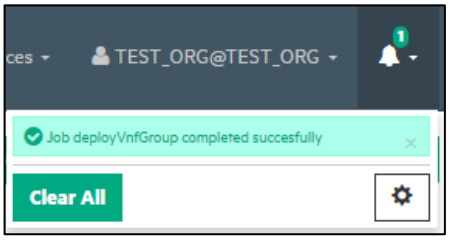


Figure 106: VNF Group activation completed message in the notification area

The job status is changed to **OK** in the **Jobs Monitor**.

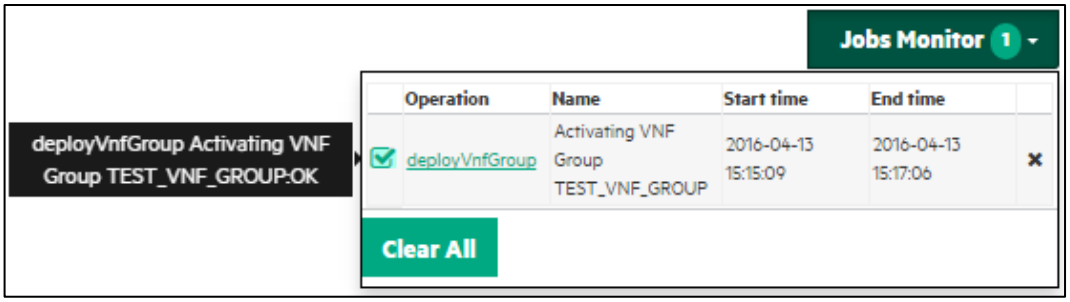


Figure 107: VNF Group activation completed in the Jobs Monitor

After the job is completed, refresh the table to see that the VNF Group status has changed from I**NSTATIATED** to **ACTIVE**.

1.4.7.3 Editing a VNF Group

Only the **Description** field can be updated in a VNF Group. The **Name** and **Datacenters** fields are disabled.

Figure 108: Error removing VNF Group DC message

Follow these steps to edit an existing VNF Group.

1) Select the VNF Group and click **Edit VNF Group** under **Actions**.
2) Change the VNF Group description.
3) Click **Save**.
4) Click **Yes** in the confirmation window.

Figure 109: VNF Group Editing confirmation window

After VNF Group editing is completed, a confirmation message is displayed in the notification area.

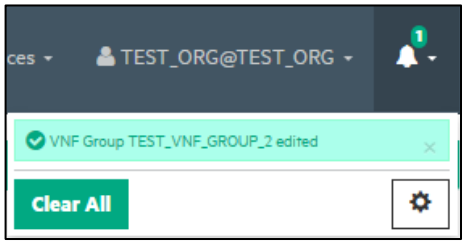


Figure 110: VNF Group edited message in the notification area

1.4.7.4 Deleting a VNF Group

Only **VNF Groups** without active VNFs can be deleted. Otherwise, this option will not be available.

Follow these steps to delete a VNF Group.

1) Select the VNF Group to delete, left-click **Actions** and select **Delete VNF Group**.

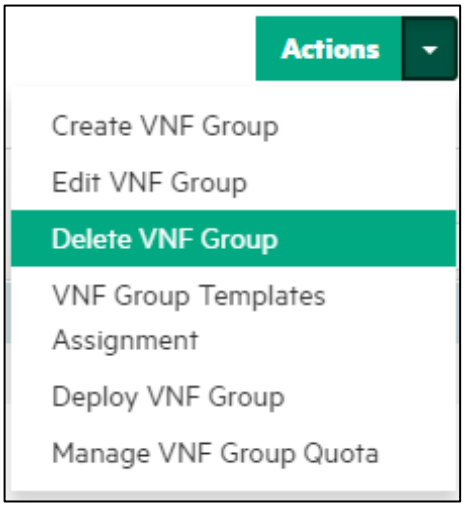


Figure 111: Delete VNF Group action

A confirmation window is displayed.

Figure 112: Delete VNF Group confirmation window

2) Click **Yes** in the confirmation window. After activation has been launched, a message is displayed in the notification area.

Figure 113: Deleting VNG Group message in the notification area

The **Jobs Monitor** displays a feedback.

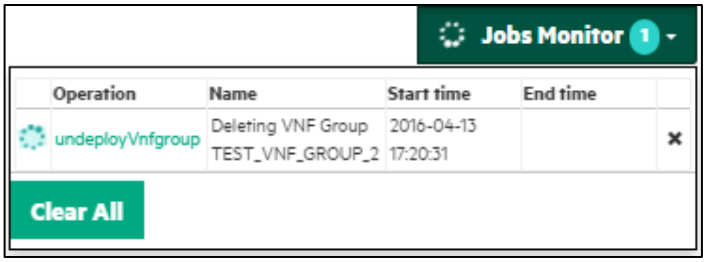


Figure 114: Delete VNF Group feedback in the Jobs Monitor

Click the **undeployVnfGroup** link in the **Jobs Monitor** to follow the activation job progress.

3) When the delete job is completed, a message is displayed in the notification area.

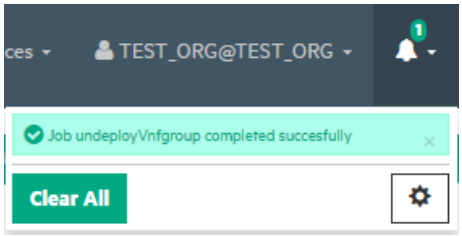


Figure 115: VNF Group delete completed feedback in the notification area

The job status is changed to **OK** in the **Jobs Monitor**.

Figure 116: VNF Group delete complete feedback in the Jobs Monitor

After the job is completed, refresh the table to see that the VDC status has changed from I**NSTATIATED** to **ACTIVE**.

1.5 VNF Group Level

1.5.1 VNF Group Entity

The VNF Group Entity represents a group of VNFs that are deployed or can be deployed in a VDC. This VNF Group is intended for management purposes.

1.5.2 VNF Group Users

A VNF Group User is intended to manage a specific VNF Group in an Organization VDC. The VNF Group can be registered by a Domain User, an Organization User, a VDC, or another Group User.

Currently this user type can only manage VNF Groups, so the Group must be specified when creating the user in the NFVD Portal.

When a VNF Group User creates another User, they can only assign their own VNF Group. If the Group User is created by a VDC User, its associated VNF Group has to belong to the user's VDC.

The following table indicates the profiles and operations available for a VNF Group User.

Table 6: VNF Group User Profiles and Operations

Profile	Operations
Administrator	Manage VNF Group Users
Provisioning	Manage Jobs Manage Monitors Manage Storage Manage VNFs Manage VNF Group Images Manage VNF Group Template Catalog View VDC Manager Check Quotas VNF Groups View Jobs
Template Designer	Manage VNF Group Templates
Monitoring	

1.5.3 VNF Group Resources

A Group can only use resources available in its Datacenters. Such resources will be used to deploy VNFs in that VNF Group.

When a Group is registered by an Organization User or a VDC User its associated Datacenters have to be indicated. You can assign a new Datacenter to a Group by editing it, but you cannot remove one.

The Quotas that can be assigned to a Group are restricted to quotas available in its Datacenters.

1.5.4 VNF Group Quota

The VNF Group Quota determines the quantity of resources that can be used in that VDC for deploying VNFs. Organization and VDC Users can manage a VNF Group Quota.

Follow these steps to manage VNF Group Quota.

1) Left-click **Administration** and select **VNF Registration & Management** to display the available VNF Groups screen.

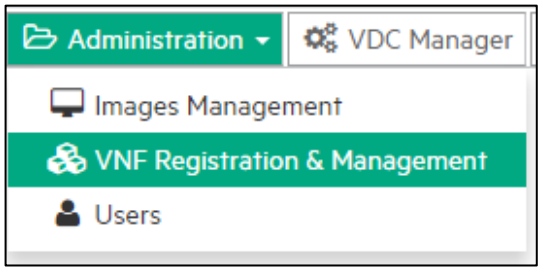


Figure 117: VNF Registration & Management option

2) Select the Group, left-click **Actions** and select **Manage VNF Group Quota**.

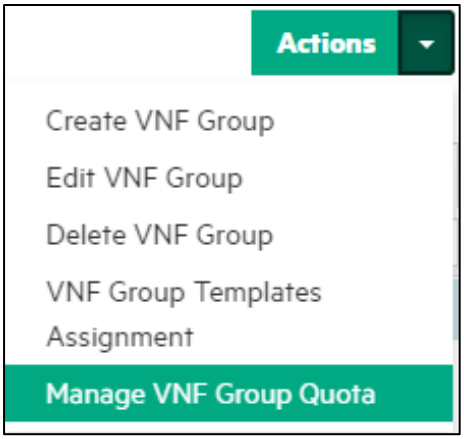


Figure 118: Manage VNF Group Quota action

This will display the **Manage VNF Group Quota** screen.

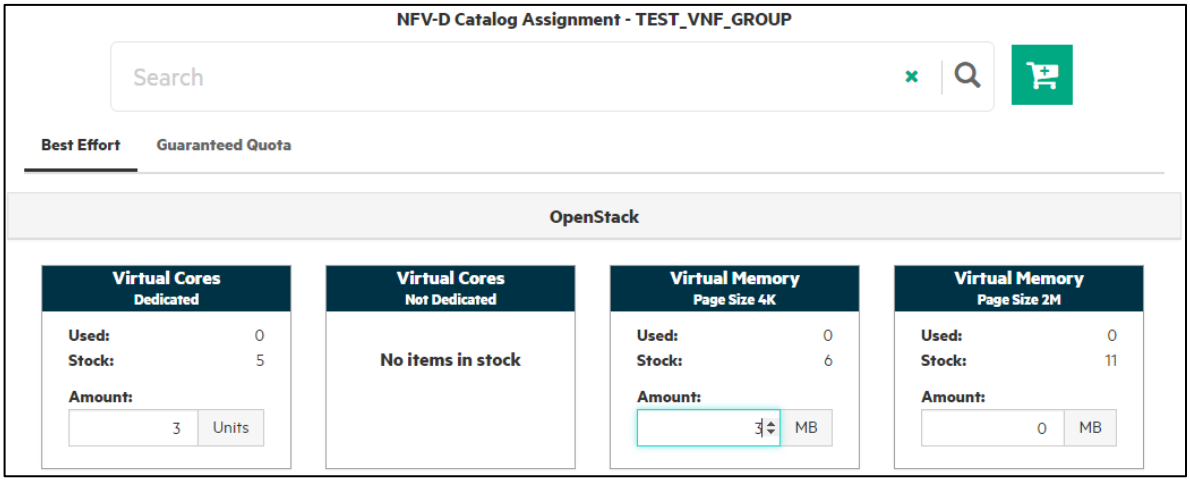


Figure 119: Manage VNF Group Quota

The quota available to a VNF Group is restricted by its VDC Quota. Refer to *VDC Quota* section for additional information.

1.5.4.1 VNF Group Resource Inventory (Quota Summary)

VNF Group Users can access a summary of their VNF Group.

Click the **Resource Inventory** option as a VNF Group user to access your VNF Group Quota.

Figure 120: Resource Inventory

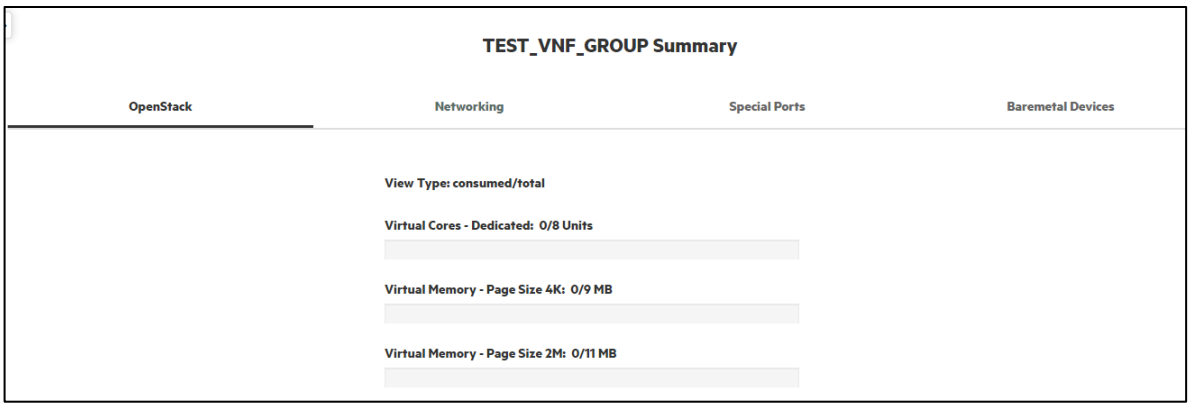


Figure 121: VNF Group Summary screen

1.5.4.2 VNF Group Quota Quick View

Click the **Quick View** icon (always available on the left side of the screen) as a VNF Group User to view your VNF Group Quota Consumption and total for every Quota type.

Figure 122: VNF Group Quota - Quick View icon

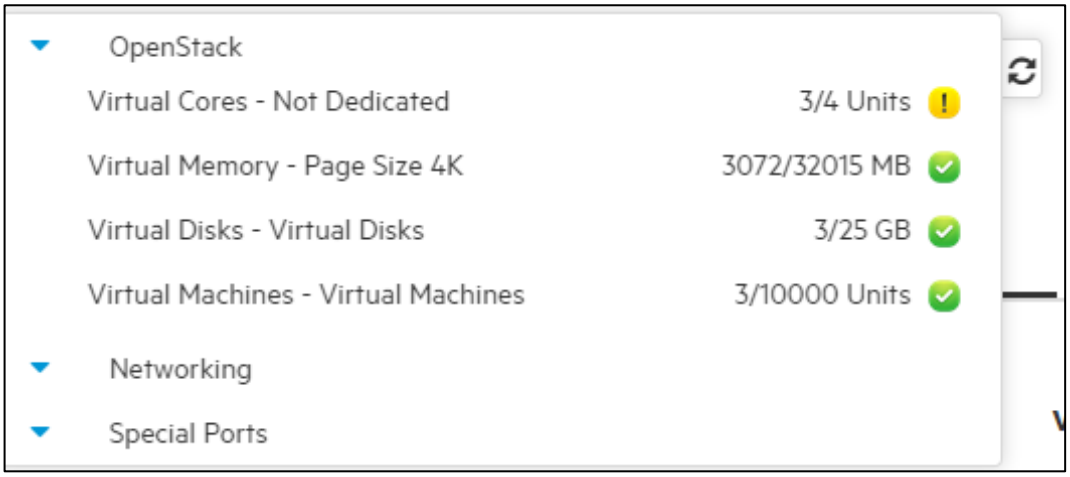


Figure 123: VNF Group Quota Quick View Navigation

Click the refresh icon to refresh the Quota information.

Figure 124: VNF Group Quota Quick View Refresh icon

Figure 125: VNF Group Quota Quick View refreshing

1.5.5 VNF Group Catalog

A VNF Group Catalog is a set of VNF Templates assigned to that specific VNF Group. The VNF Group Templates are available to be instantiated in that VNF Group.

A VNF Group Catalog can be managed by an Organization User or a VDC User.

Follow these steps to make changes in a VNF Group Catalog.

1) Left-click **Administration** and select **VNF Registration & Management** to display the **VNF Group Management** screen.

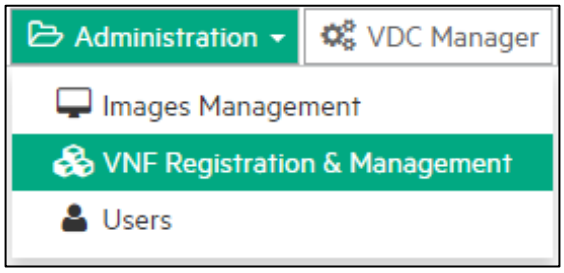


Figure 126: VNF Registration & Management option

2) Select a Group, left-click **Actions** and select **Template Assignment VNF Group**.

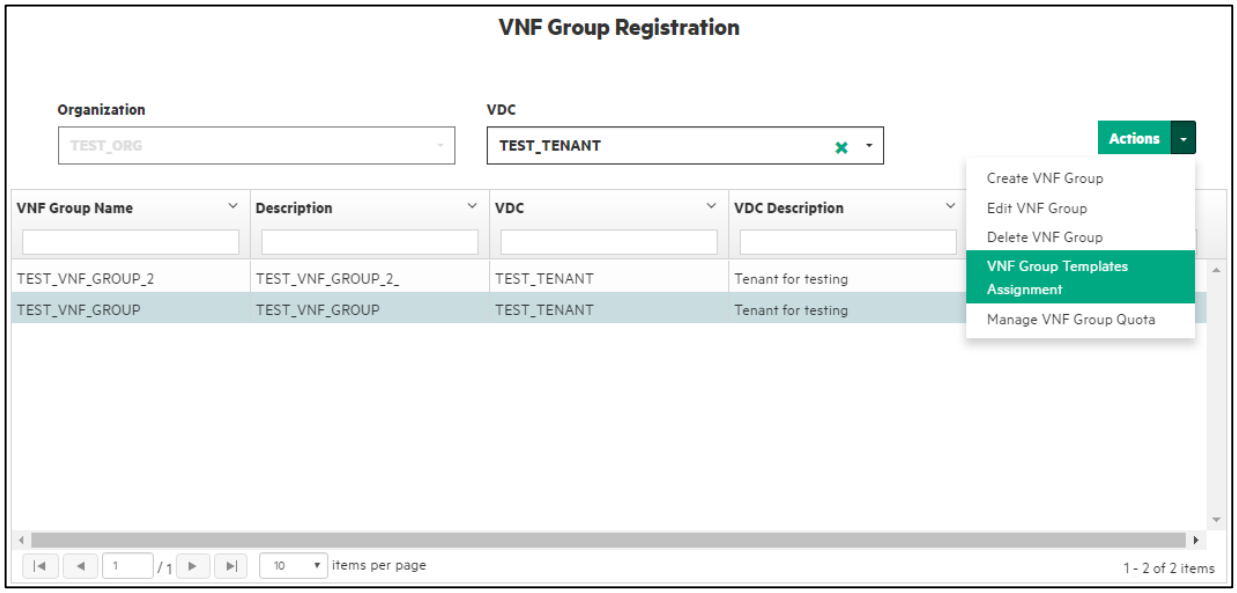


Figure 127: VNF Group Templates Assignment action

The new window indicates all the VNF Templates assigned to the user's VNF Group.

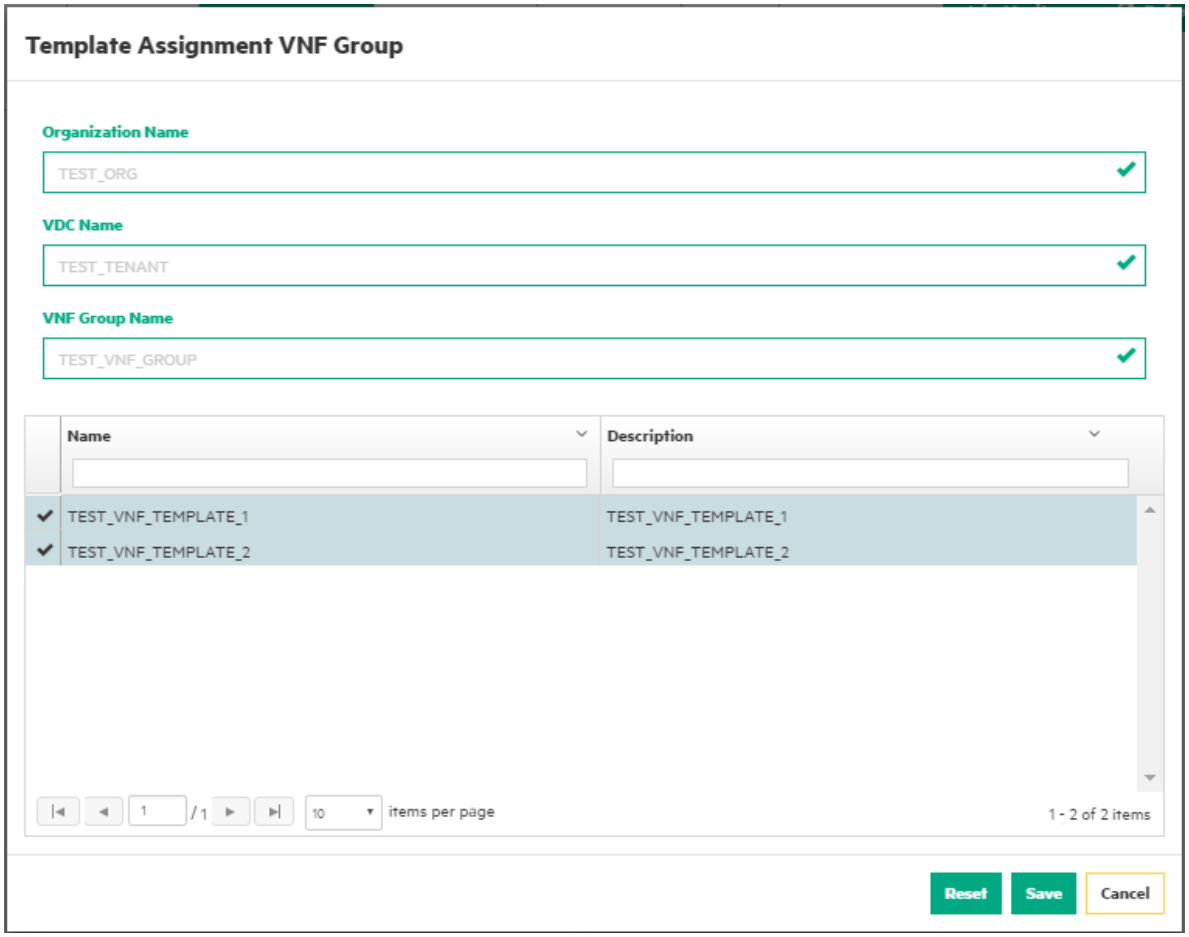


Figure 128: VNF Group Template Assignment

3) Select all Templates to add to the VNF Group Catalog, unselect the ones to remove, and click **Save**. A confirmation window will be displayed.

Figure 129: VNF Group Templates Assignment confirmation window

4) Click **Yes** in the confirmation window. This will also refresh the Templates table of the selected VNF Group.

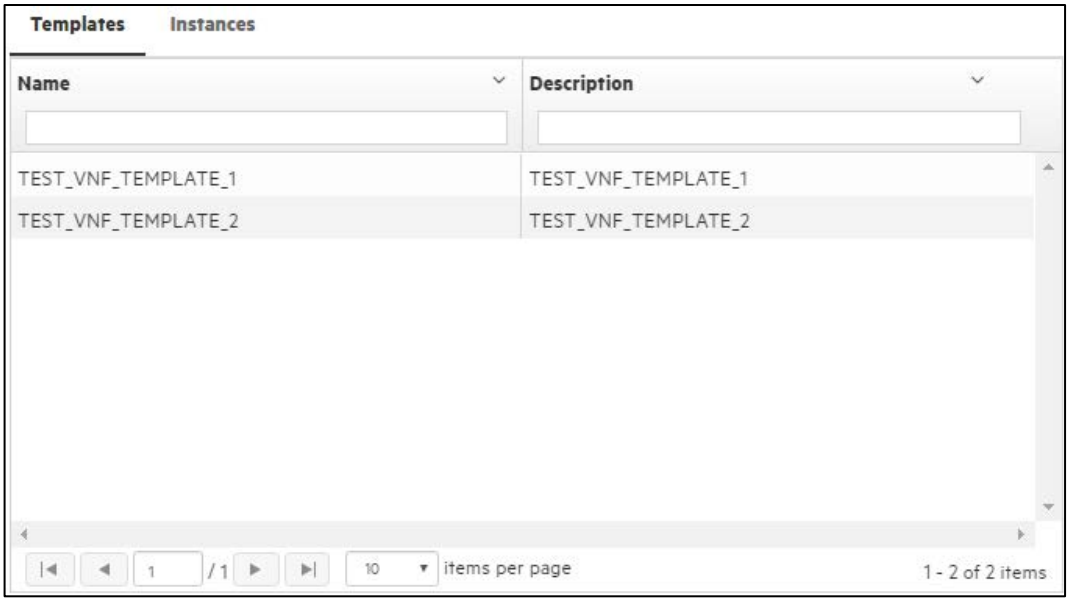


Figure 130: VNF Group Templates table

1.5.6 VNF Group Image repository

The VHF Group Image repository contains all the Operative Systems Images that can be deployed in a specific VNF Group. A VNF Group User can register and upload an Image from the NFVD Portal and make it either public (accessible to other users) or private.

Refer to the NFV Director Images Management chapter for additional information on Image Management.

Chapter 2
NFV Director VDC Manager

2.1.1 Introduction

The **VDC Manager** provides a graphical representation of a VDC and allows operations for virtual resources including VNF, VMs, monitors, or storage. In particular, the **VDC Manager** is used to deploy VNFs, perform and monitor day-to-day operations.

The **VDC Manager** access requires **VDC** role.

2.1.2 VDC Manager screens

2.1.2.1 Main screen

Once the user has logged in and has selected the **VDC Manager** in the top menu, a screen similar to the following illustration is displayed.

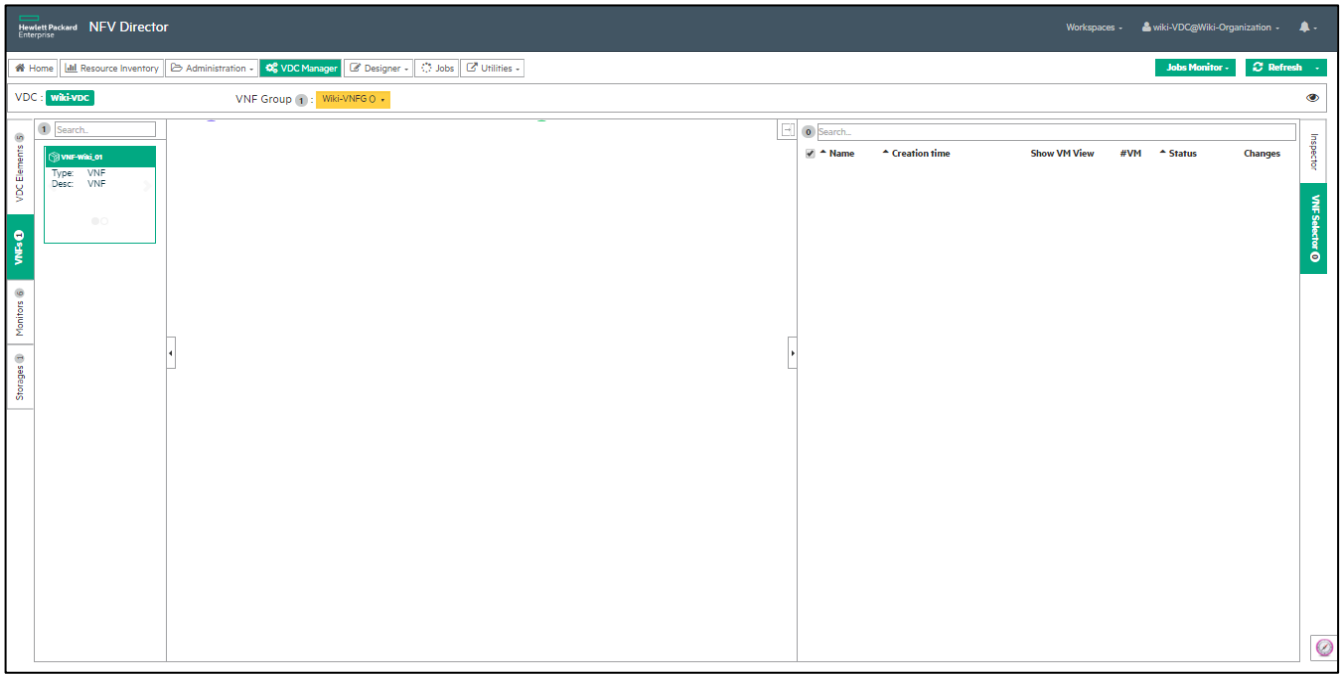


Figure 131: VDC Manager Main screen

Besides the top menu, the **VDC Manager Main screen** is divided into three sections. The leftmost section lists all Templates ready to instantiated, grouped by categories.

- VDC Elements, including networks and firewalls
- VNFs
- Monitors
- External Storage (VLUN)

The **VNFs** section contains the VNF Templates created with the designer, saved and published by the user.

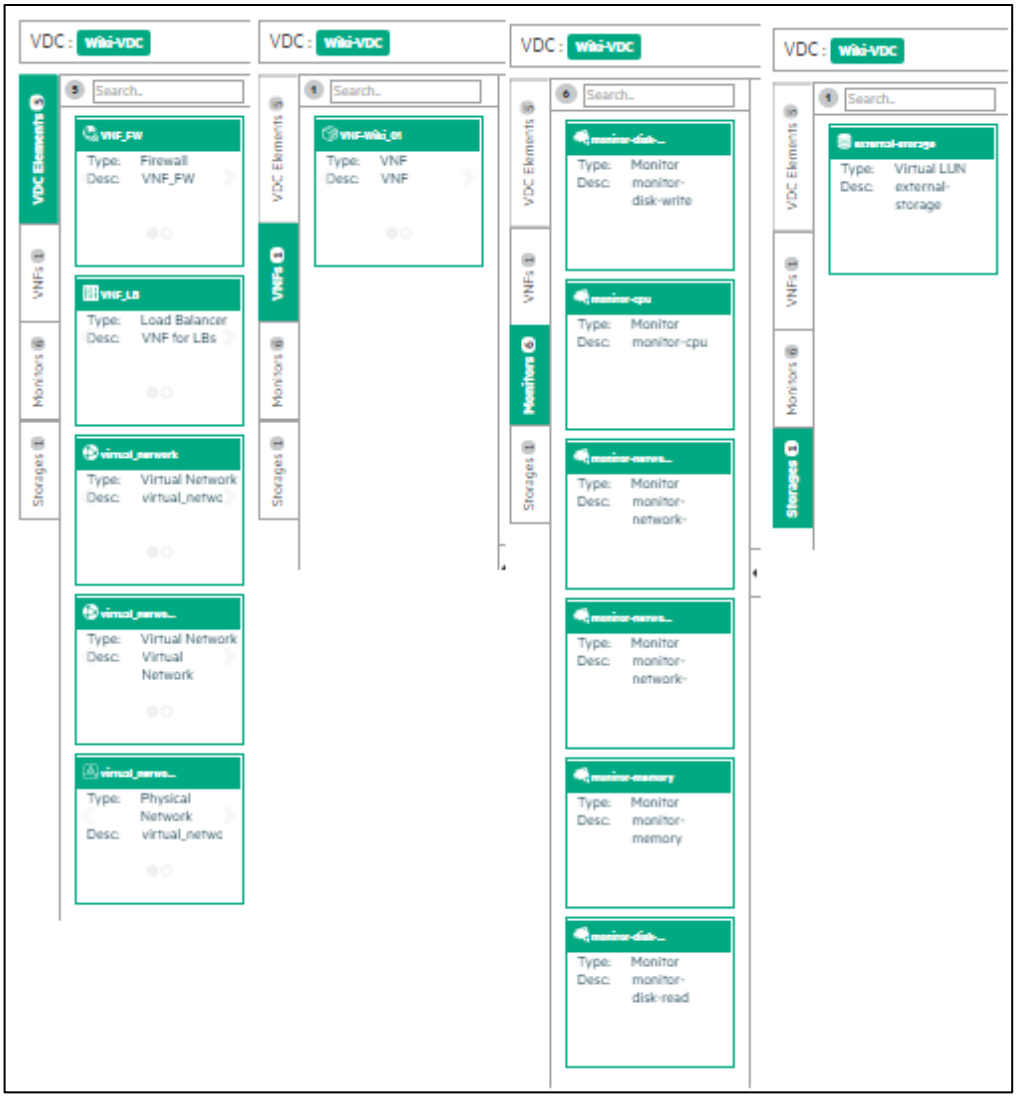


Figure 132: Available VDC Manager elements

The central section of the **VDC Manager** represents the workspace or VDC drawing area. This is where the user will drag all the necessary components to connect, edit, and operate on the elements. Depending on the operations, the components will change their status. These include component color change in the work space or the shape of the line that represents the connection between components. Each change in the workspace is designed to be intuitively detectable.

The third section, the right side, of the **VDC Manager Main screen** is where the **VNF Inspector** and the **VNF Selector** are located.

The **VNF Inspector** is used to display and edit each element's attributes. The **Inspector** pops up automatically when an element is selected in the workspace.

The **VNF Selector** lists the VNF instances currently deployed in the VDC. The **VNF Inspector** can be accessed by clicking on one element in the **VNF Selector**.

The **VNF Inspector** and the **VNF Selector** will be described in more details later in this guide.

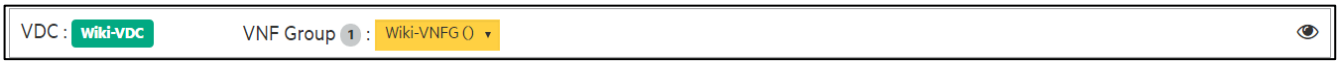


Figure 133: VDC Manager top menu

The **VDC Manager top menu** has three elements from left to right:

- **VDC** indicates the user currently logged in and using the **VDC Manager**. In the previous illustration, it is Wiki-VDC.
- **VNF Group** indicates the number (circled) of VNFs available from the VDC to be used in the **VDC Manager**.
- **Enabled/Disabled icon** (or) indicates the Firewall status.
    - Enabled: the workspace displays the VNF:FW.
    - Disabled: the workspace displays only the virtual networks present.

One of the most important elements of the **VDC Manager Main screen** is the compass symbol in the bottom right corner of the window. When the user left-clicks this element, a small window indicating a miniature view of the workspace is displayed in the same corner of the **VDC Manager**. Depending on the number of connected entities, the workspace view could be difficult to manage. This zoomed out view lets you easily browse through the VDC. The following illustration shows the workspace with three Virtual Networks instantiated and the zoomed out view.

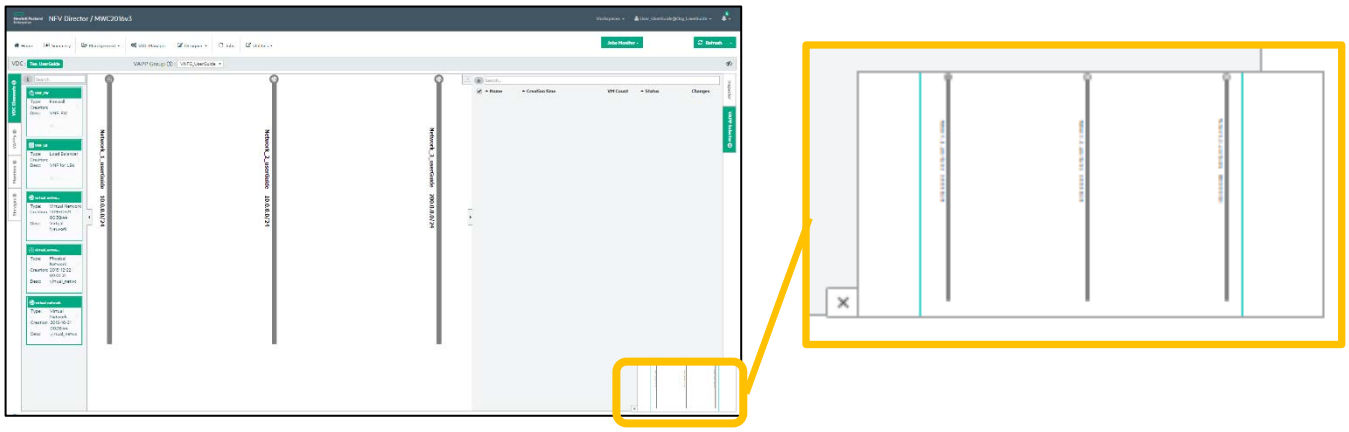


Figure 134: VDC Manager workspace with zoomed-out view

The blue lines indicate the borders of the screen visible at one time. Up to three networks can be viewed comfortably on the screen, but as more components are introduced in the workspace, the mini-map feature become very useful.

2.1.2.2 VDC Manager Inspector

The **VDC Manager Inspector** allows the editing and checking component's attribute. The **FW_UserGuide** component is displayed in the following illustration. This component is in a primary status, meaning that the element was recently instantiated and remains inactive. When selecting the element, the **Inspector** will display the structure inside the component.

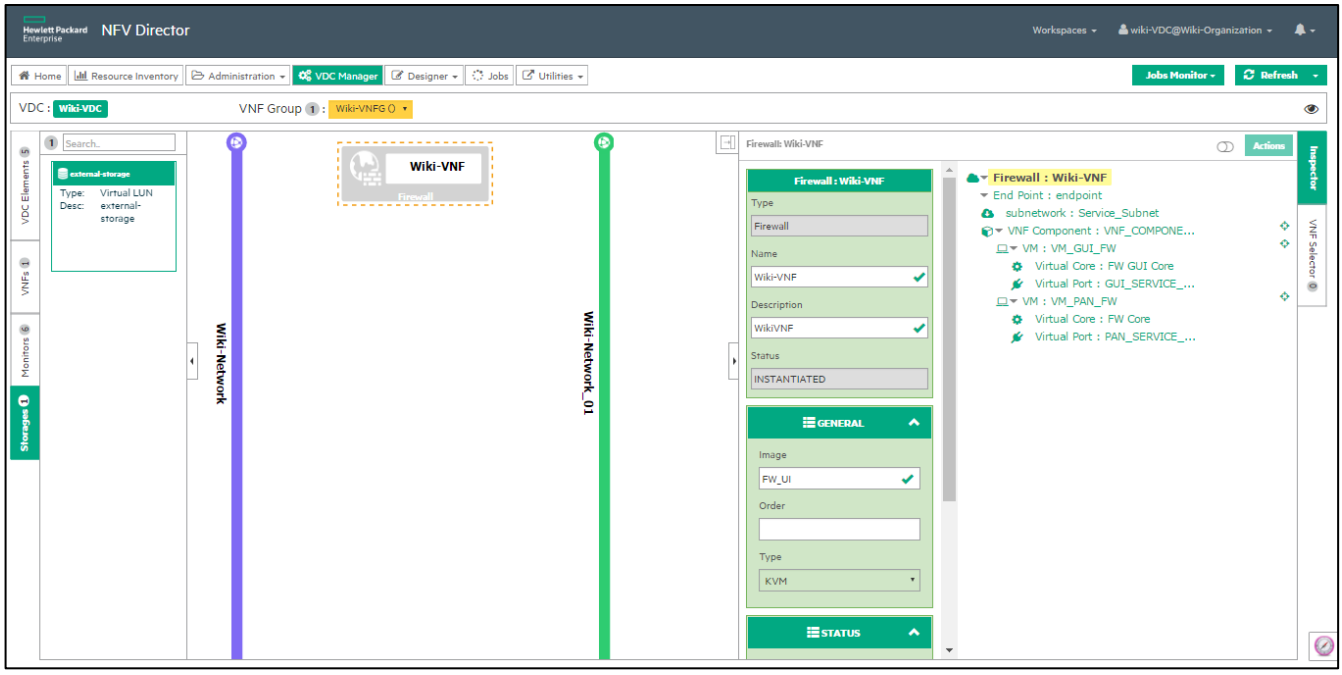


Figure 135: VDC Manager Inspector

Selecting the network in the left side of the work space will display the information about the specific component.

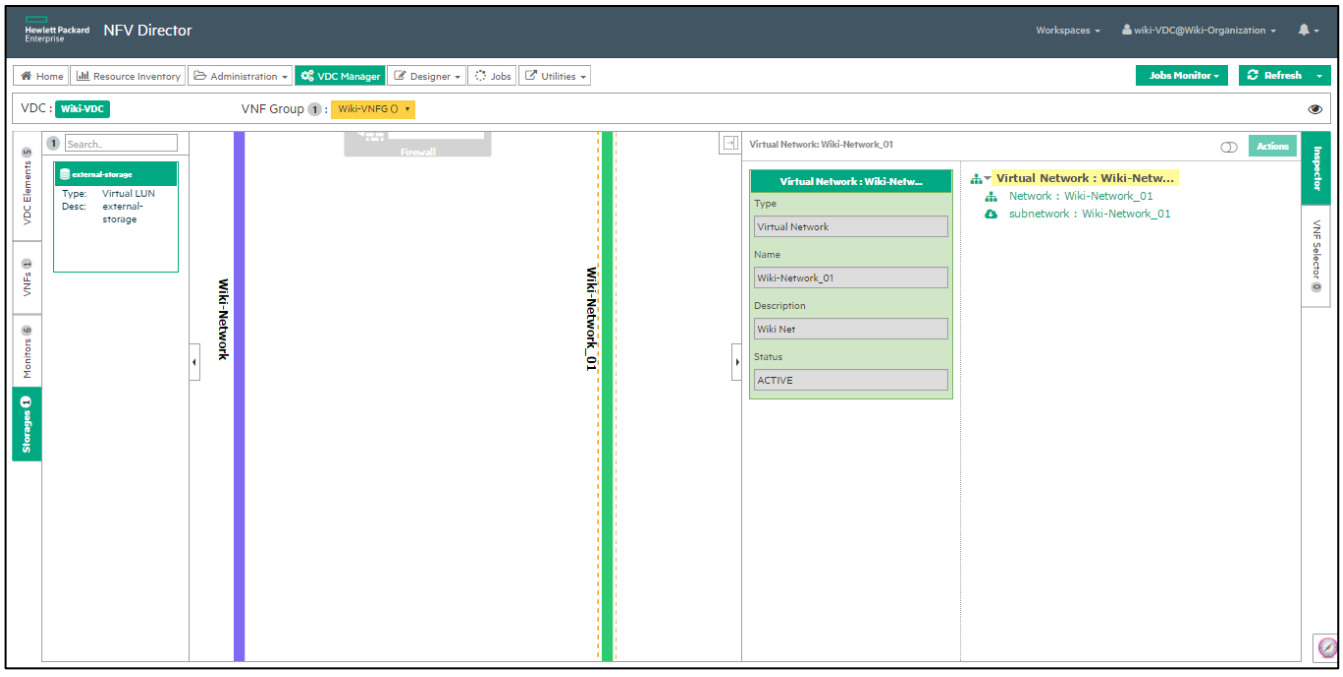


Figure 136: VDC Manager Inspector

A useful feature of the Inspector provides the user direct access to the Virtual Machines present in the component, and vice versa. This feature is represented by a scope sym ( ) displayed near the accessible elements.

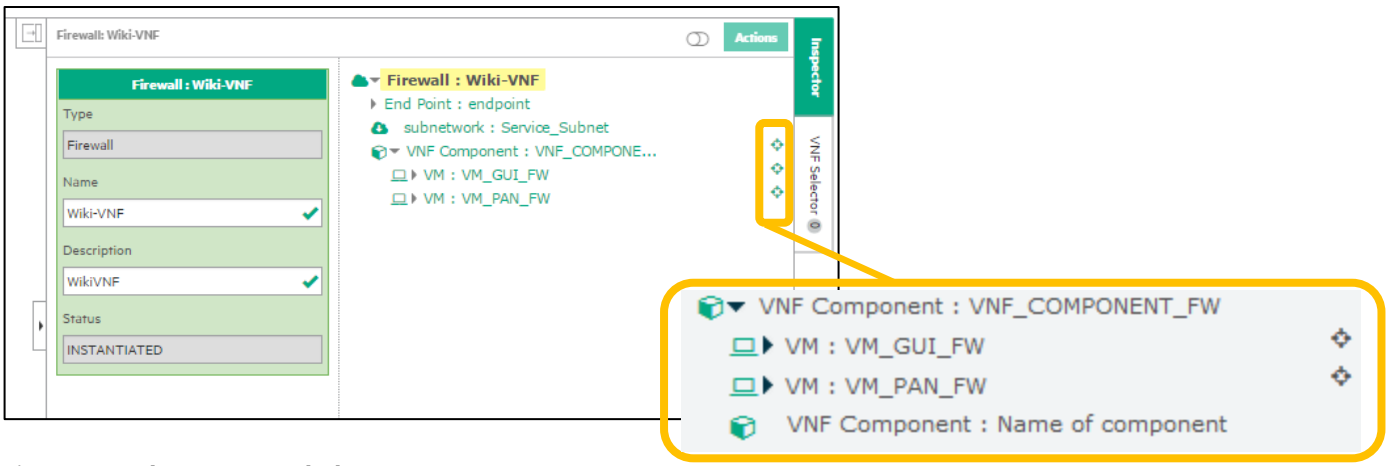


Figure 137: The scope symbol

The primary elements suitable for scoping are Virtual Machines. Left-clicking the scope symbol will display the Virtual Machine owned by the element with the scope feature, and will navigate to the corresponding VM Inspector. In order to return to the Virtual Machine parent element, left-click the dark green scope symbol in the top right corner of the attribute inspector window.

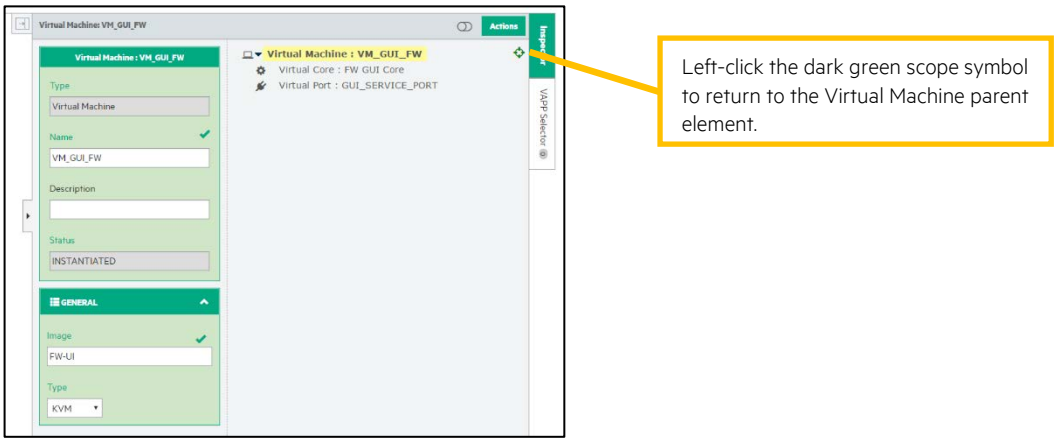


Figure 138: Return from scoping

The **Actions** switch in the **Inspector** title bar hides or displays all attributes of an instance, regardless of their visibility. This is useful for debugging. The **show all** mode displays all of the, mostly read-only, attributes.

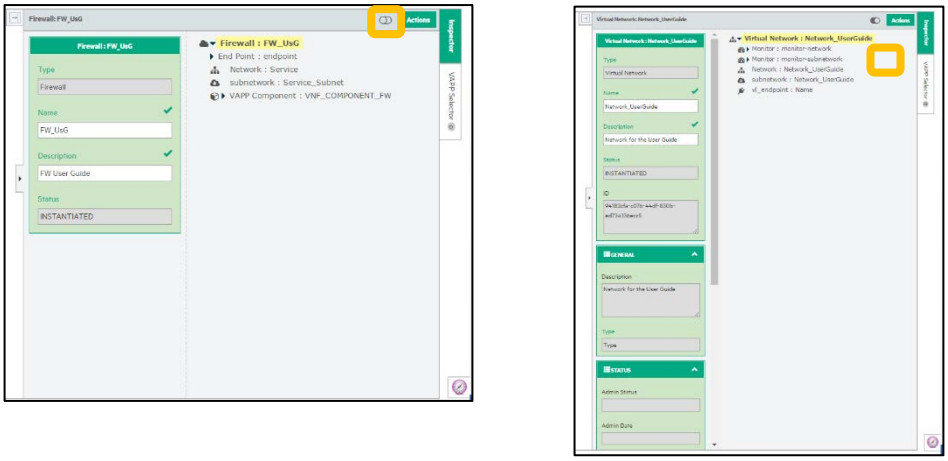


Figure 139: Enable/disable attributes window

The other element present in the top menu is the **Actions** button. Clicking this button displays a pop-up menu with all the operations available for the specific component. The actions' availability depends on the role of the user currently logged in.

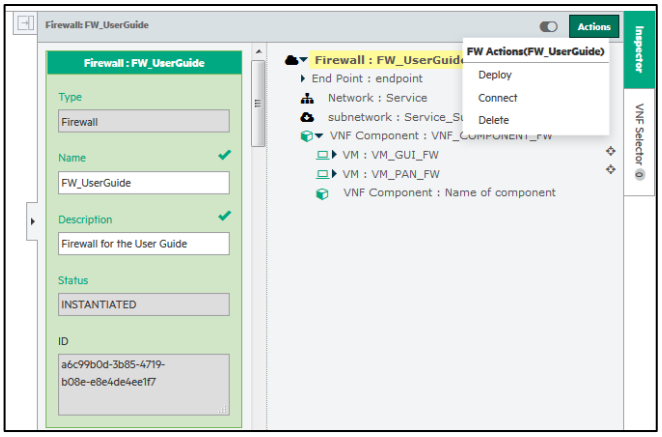


Figure 140: The Actions button

2.1.2.3 VDC Manager VNF Selector

The VDC Manager's **VNF selector** lists the selected VNF Group's VNF instances. These VNFs can be instantiated or deployed.

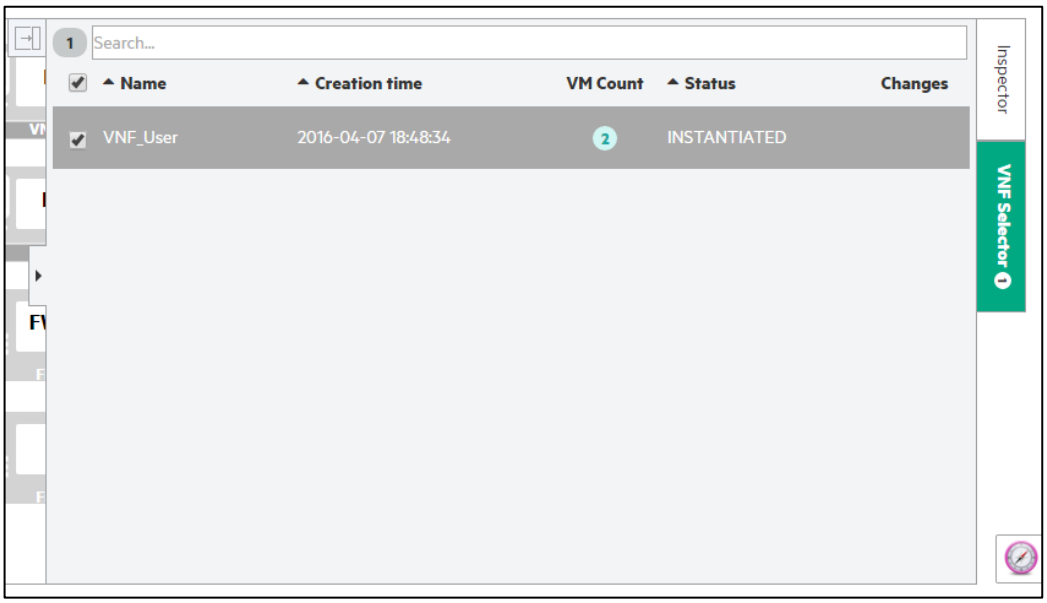


Figure 141: VDC Manager VNF Selector

As you can see in the previous illustration, the selector lists the **VNF_User** component, which was created from the designer. This component displays the number of Virtual Machines, along with the actual status of the component, and the creation timestamp. Clicking an item in the **VNF Selector** opens the **VNF Inspector**.

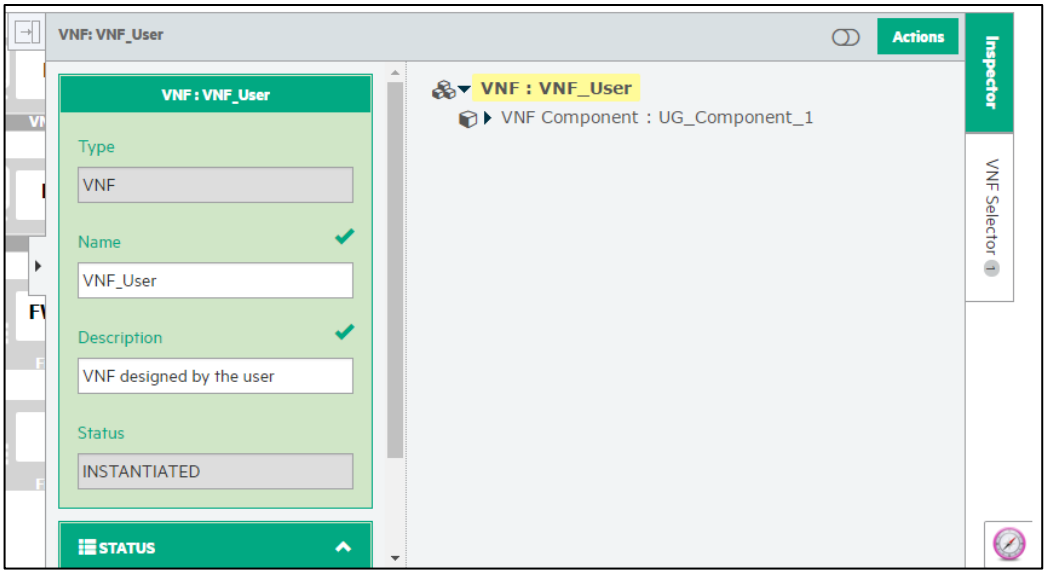


Figure 142: VNF Inspector

2.1.2.4 Updating VDC Manager attributes

Attributes of non-deployed instances can be modified. Once a VNF is deployed, instances become read-only. After modifying attributes from an Inspector, changes have to be finalized with the **Update** operation. The result of the **Update** operation is global in the **VDC Manager**, meaning that all the modified attributes are stored regardless of element definition. This means that all modifications can be saved with a single **Update**.

There are two ways to initiate an **Update**:

- Left-click **Actions** and select **Update**.
- Right-click in the element previously selected in the workspace. The **VDC Manager** will display a list of actions available for the element.

NOTE: The workspace represents the VDC itself so it is enough to right-click in the empty region of the workspace to display the list of operations available for the element.

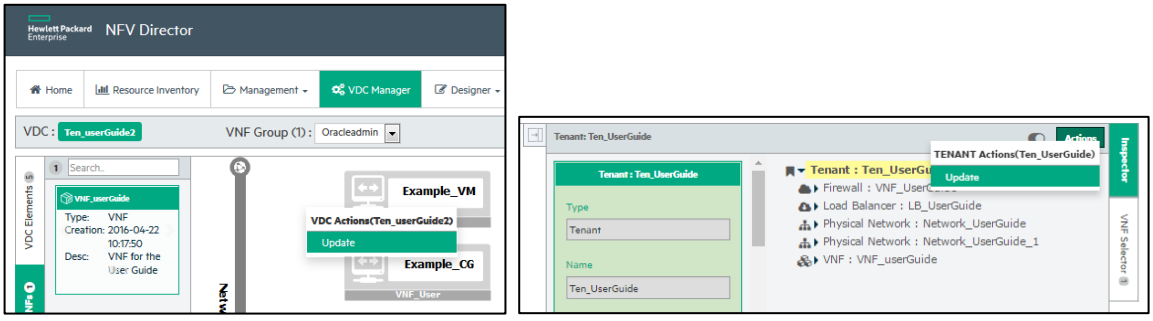


Figure 143: Updating VDC attributes

Left-click **Update** in the menu to execute a VDC workspace update. A window similar to the one in the following illustration will be displayed.

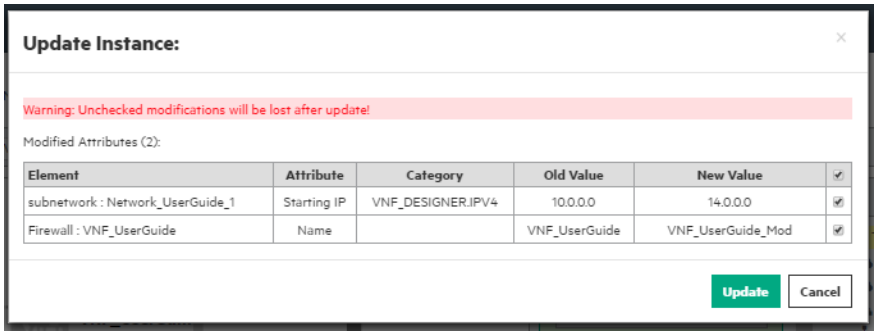


Figure 144: Update confirmation window

This window displays the modifications to be saved. In this case the IP address of a subnetwork owned by one of the virtual networks in the workspace was edited, as well as the **VNF_UserGuide** name. Click **Update** to start the update process. If the update was successful, a message similar to the one in the following illustration is displayed and the job is registered in the **Jobs Monitor**.

Click the  symbol to view the message.

Figure 145: Instance update confirmation message

2.1.2.5 VDC Manager and the Management Network

There are two types of main VDCs that can be managed by the solution:

- **Standard VDC**, or
- **Management VDC** with network type **IPv4** or **IPv6**

This means we really have three types of VDCs. The difference between them is that the last one is associated with a **management_network**. This network is responsible for the communication between various entities needed by the VDC for correct operation. **The Management Network is hidden from the users** because the user will not need to modify any feature or attribute of the Management Network directly. This is also a security measure, because the Management Network carries out certain sensitive VDC management processes.

Also, the **Management Network** will allow communication between Datacenters in a multi-datacenter environment, where the **Management Network**, as stated previously, will remain hidden from the users.

The presence of the Management Network is also critical when the Datacenter/Resource Pool is going to be used with a DCN environment (SVN Platform, besides the OpenStack Platform). If the Datacenter was designed to be used with both platforms, apart from the DCN structure that has to be implemented in the datacenter, the VDC must be **Management** type, in order to have a management network properly configured for the future operations.

This type of VDC and network is also crucial for a specific VNF, the Firewall. Without a management VDC and a Datacenter specifically designed for both platforms, the **VNF Firewall** activation will fail.

NOTE: The **Management Network** is not the external network. The external network will only be visible in the **VDC Manager** when a **Management VDC** is used, and the external network will develop the communication between the machines and networks not managed by the solution or the OpenStack platform.

2.1.3 Virtual Network operations

Left-click **VDC Elements** to operate with networks in the **VDC Manager**. There are three types of suitable Virtual Networks detailed in the following sections.

2.1.3.1 Virtual Network attributes

The majority of all Virtual Networks' attributes and categories are similar with small additions or configurations. This section details the specific attributes of the Virtual Networks.

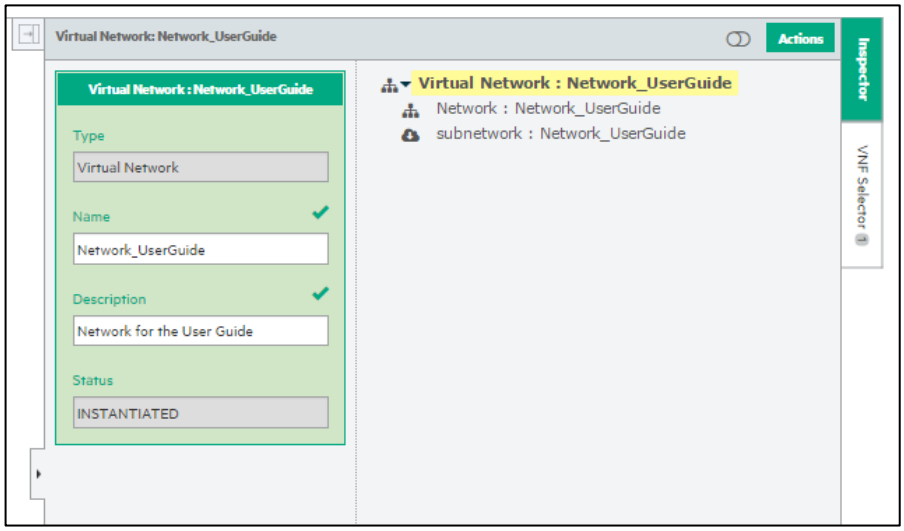


Figure 146: Virtual Network attributes

The previous illustration indicates the general attributes of the Virtual Networks. In this case the **Type** and **Status** attributes are disabled. Left-click in the **Name** and **Description** fields to edit their values.

These attributes are common to all Virtual Networks, as the elements that conforms the element, a VN always is going to have at least a Network and a Subnetwork.

The unique primary difference between the standard Virtual Network and the rest are small changes. The **Monitored Virtual Network** has two monitors already set to use, just as the **Physical Virtual Network**. The attributes of the Networks and Subnetworks are the same in both.

2.1.3.1.1 The attributes of a Virtual Network's network

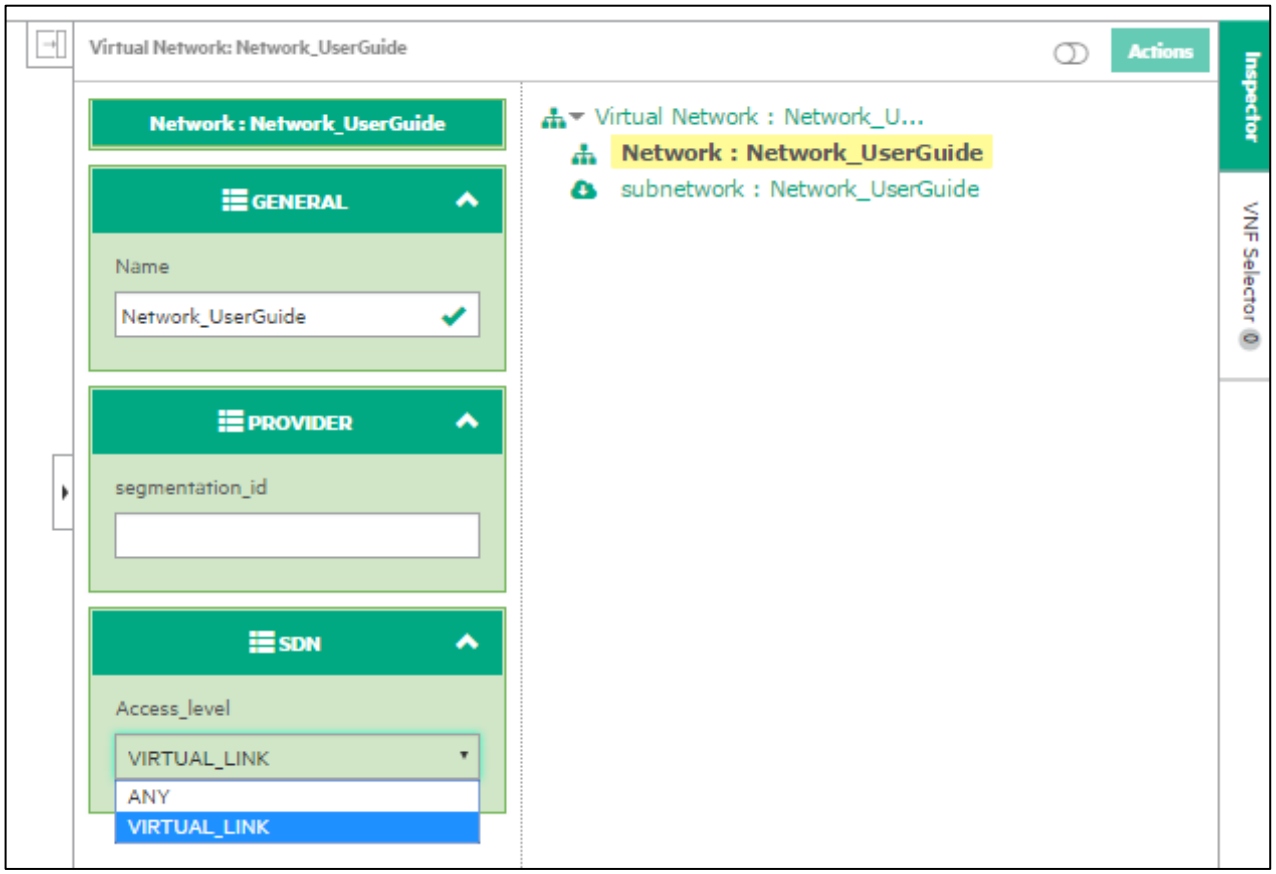


Figure 147: Virtual Network SDN category

The previous illustration indicates the selected Network, and the category and attributes of the Network part of the Virtual Network. These are minor components when working with the **VDC Manager**, so the only editable attribute of the Network is **SDN.Access_level**. This attribute can take only two possible values, **ANY** or **VIRTUAL_LINK**, so the Network is only going to gain access through the Virtual_Link.

If SDN Access level is set to **VIRTUAL_LINK**, then the Virtual Machines connected over that Virtual Link will only have access to that specific Virtual Link Subnetwork. Otherwise, if it is set to **ANY**, the Virtual Machines will be able to reach other ranges, either Internet or Virtual Links with access level set to **ANY**.

For example:

- If we create 3 Virtual Links
  - NET1 with subnet range 10.0.0/24 and Access level ANY
  - NET2 with subnet range 20.0.0/24 and Access level ANY
  - NET3 with subnet range 30.0.0/24 and Access level VIRTUAL_LINK
- Then
  - VM in NET1 will be able to ping (with appropriate routes) VMs on NET1 and NET2
  - VM in NET1 will NOT be able to ping VMs on NET3 unless there is a FW or LB in between NET1 and NET3
  - VM in NET2 will NOT be able to ping VMs on NET3 unless there is a FW or LB in between NET2 and NET3
  - VM In NET3 will be ONLY able to ping VMs on NET3

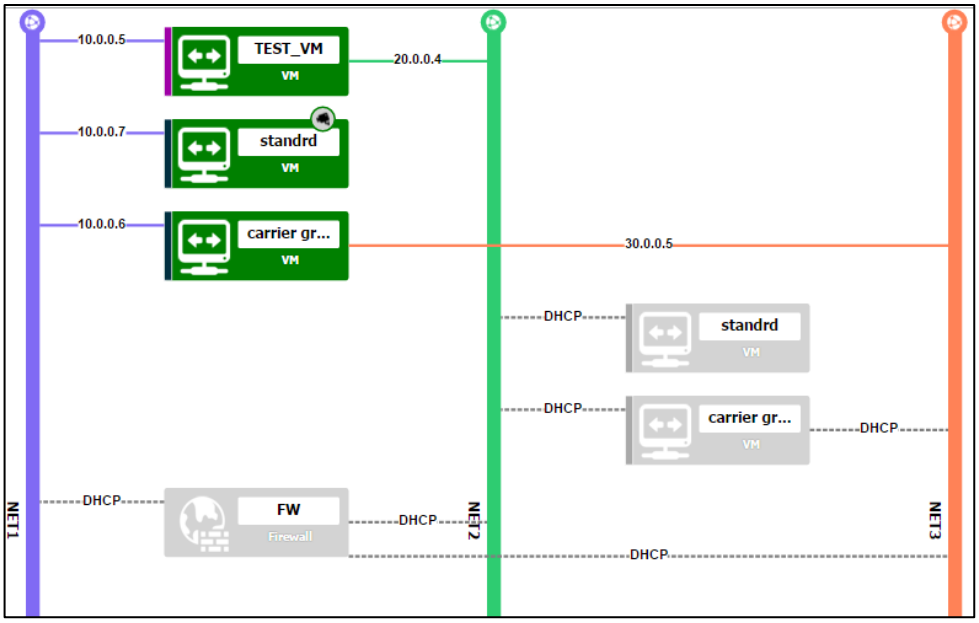


Figure 148: Possible connections for various Virtual Networks

2.1.3.1.2 The attributes of a Virtual Network's subnetwork

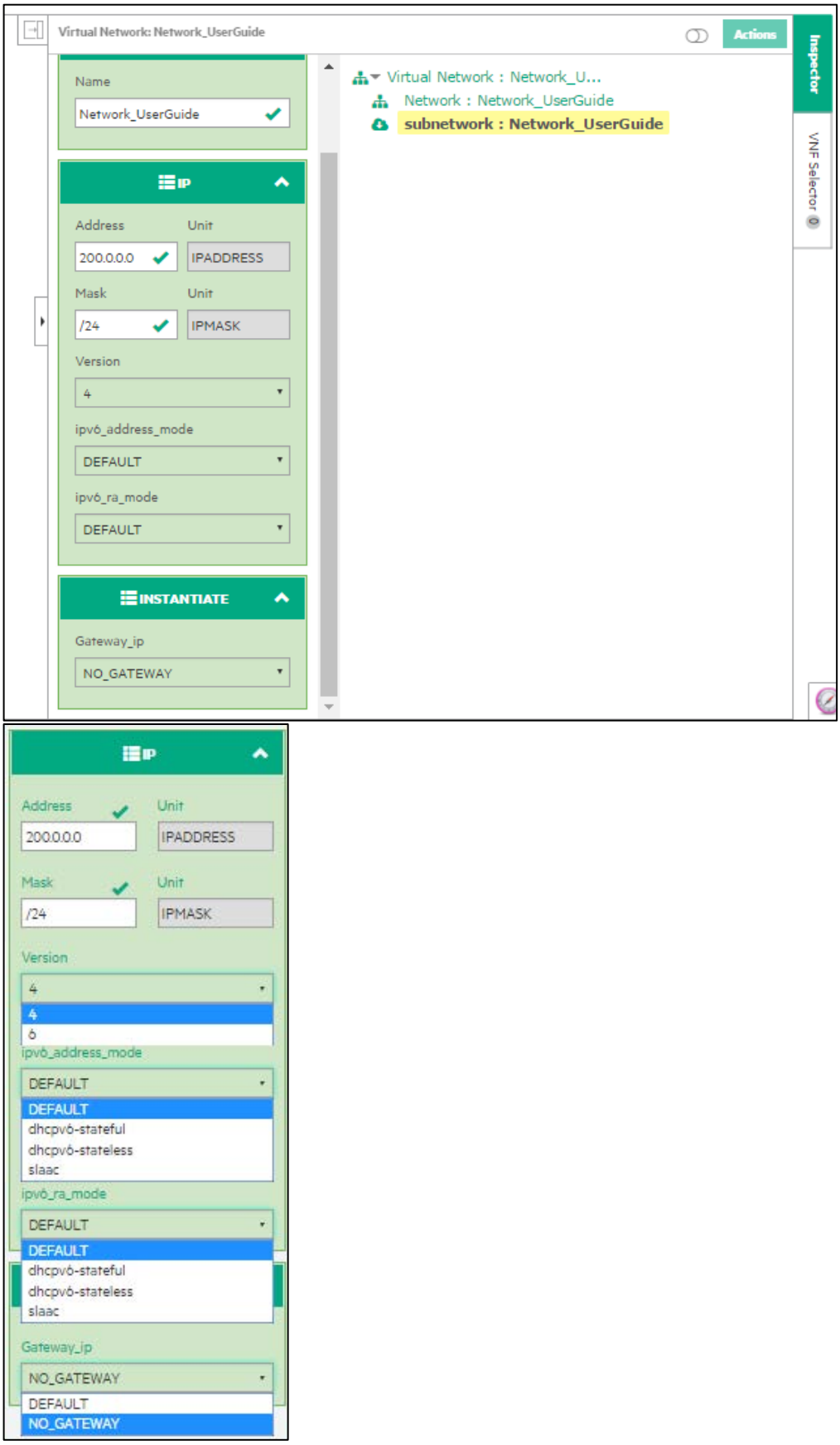


Figure 149: Attributes of a subnetwork

The previous illustrations indicate (with the subnetwork selected) the categories and attributes of the subnetwork that is part of the Virtual Network. There are two categories that the user is allowed to edit.

The first one, **IP**, has five editable attributes:

- **Address**: The IP address in the illustration is set to **200.0.0.0**. Choose the IP address for the subnetwork with care, make sure it is unique. This address can be for IPv4 or IPv6, but you must specify a valid IP. Note: Must be consistent with the field “Version”.

NOTE: This value must be consistent with the **Version** field.

If the range selected on the subnetwork **overlaps** with another range you **may** receive an error during deployment. If you are using a multi-site solution the IPAM plugin used in the background (at VIM level) will enforce that ranges **do not** repeat.

If you are in mono-site mode without the IPAM plugin, you can repeat the ranges with the same limitations as OpenStack.

- **Mask**: It defines the network mask number and its value depends on the IP version. In case of IPv4 valid values are between **/1** and **/30**. In IPv6 valid values are between **/1** and **/126**.

NOTE: It is necessary to put the **/** character before the mask value.

- **Version**: This value is either **4** or **6**, corresponding to IPv4 and IPv6.
- **ipv6_address_mode**: This value controls how OpenStack handles addressing. There are a number of different ways that guest instances can obtain an IPv6 address, and this attribute indicates these choices to the Networking API users.
- **ipv6_ra_mode**: This value controls router advertisements for a subnet.

  The IPv6 Protocol uses Internet Control Message Protocol packets (ICMPv6) as a way to distribute networking information. ICMPv6 packets with the type flag set to 134 are called **Router Advertisement** packets, which broadcast information about the router and the route that can be used by guest instances to send network traffic.

  The **ipv6_ra_mode** attribute specifies if the Networking service should transmit ICMPv6 packets for a subnet.

IPv6 supports three different addressing schemes for address configuration and for providing optional network information.

- **Stateless Address Auto Configuration (SLAAC)**: Address configuration using Router Advertisement (RA).
- **DHCPv6-stateless**: Address configuration using RA and optional information using DHCPv6.
- **DHCPv6-stateful**: Address configuration and optional information using DHCPv6.

You can choose any of these values or **DEFAULT**. If you are using IPv4, you must choose the **DEFAULT** value.

There are many combinations of these two attributes, but only some of them are valid. The following table explains these combinations.

Table 7: SLAAC combinations

ipv6_ra_mode	ipv6_address_mode	Result
Not specified	SLAAC	Addresses are assigned using EUI-64 and external router will be used for routing.
SLAAC	SLAAC	Addresses are assigned using EUI-64 and OpenStack networking provides routing.

Table 8: Stateful-stateless combinations

ipv6_ra_mode	ipv6_address_mode	Result
DHCPv6-stateless	DHCPv6-stateless	Address and optional information using neutron router and DHCP implementation respectively.
DHCPv6-stateful	DHCPv6-stateful	Addresses and optional information are assigned using DHCPv6.

Based on OpenStack capabilities, addressing configuration modes are only available using IPv6 and there is no mandatory configuration parameter. Accordingly, **NFV Director** operates as follows.

- **IPv4**: It always takes the **DEFAULT** value, regardless of the value selected by the user because modes cannot be applied to IPv4 networks.
- **IPv6**: It can take the values mentioned in the chain or **DEFAULT**. as Ruben correctly says. The **DEFAULT** value does not provide any value for an OpenStack request, so default Neutron configuration is provided to the network. In terms of functionality, the behavior is the same as **DHCPv6-stateful**.
- **Default value**: The default value has been provided for full compatibility between IPv4 and IPv6.

The second category for the subnetwork is **INSTANTIATE** with the **Gateway_ip** attribute that can only take two values, **DEFAULT** (use default gateway) and **NO_GATEWAY** (do not use any gateway).

If **NO_GATEWAY** is selected then the Virtual Machine will **not** get any default route via DHCP options during boot. Depending on your VM needs, this will be in effect until proper routes are set with the VM console.

If you select **DEFAULT** and connect a Virtual Machine to **two** networks both set with **DEFAULT** options, then your VM will get **two** default routes via DHCP options.

2.1.3.2 Virtual Network types

There are three types of virtual networks:

- **VIRTUAL NETWORK - GENERIC**: This represents the basic virtual network with one network and one subnetwork.
- **VIRTUAL NETWORK - EXTERNAL**: This represents a network that will come from the outside and use floating IPs, primarily for multi-site environments.
- **VIRTUAL NETWORK - MANAGEMENT**: This represents a network for internal management. This network will create the needed connections automatically with other components and will manage the infrastructure of the application. When this virtual network is activated, it will configure the correct ports and connections to offer the correct services. This virtual network will not be visible to the user.

2.1.3.3 Standard Virtual Network operations

In order to operate with networks in the **VDC Manager**, left-click in the **VDC Elements** to select the tag. Once the list of elements is loaded, select a Virtual network to be created in the workspace. There are three types of Virtual Networks suitable for operation. The following section will detail Standard Virtual Network operations.

2.1.3.3.1 Creating a Standard VN

There are two ways to create (instantiate) a Virtual Network.

a. Select the template from the list and drag it to the workspace.
b. Select the element from the list, left-click **Actions** and select **Create** from the displayed list.

When a Virtual Network is selected from the list of components, the component's border color will turn green. The system will also generate the timestamp for the component. These changes are indicated in the following illustration.

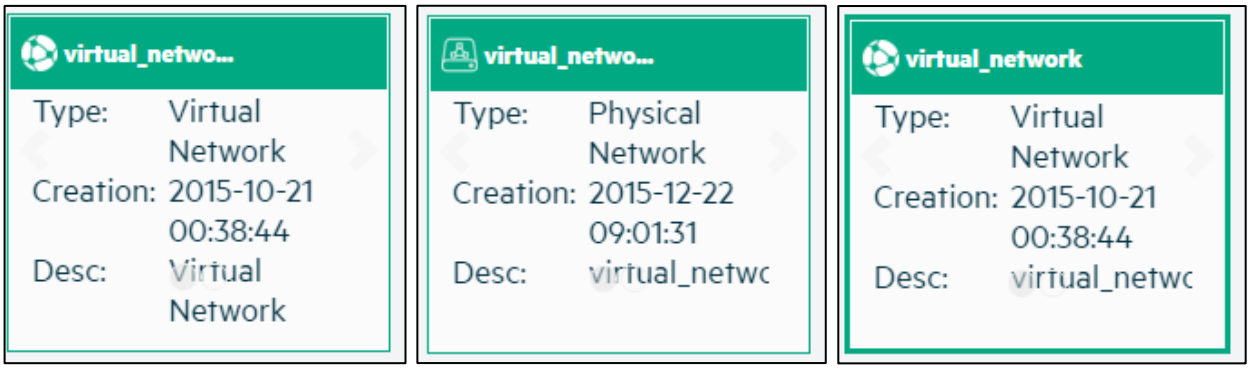


Figure 150: Three types of Virtual Networks

Regardless of the method used to create the instance, the same window will be displayed.

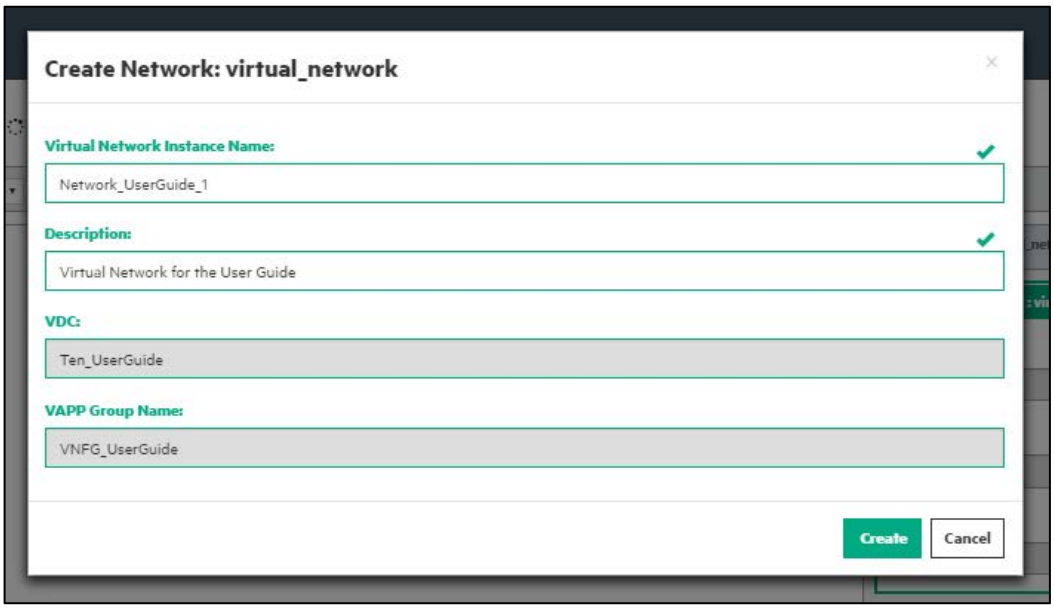


Figure 151: Create Virtual Network window

For this Virtual Network example we set the name of the network to **Network_UserGuide_1** and the Description to **Virtual network for the User Guide**. The **VDC** and **VAPP Group Name** fields are disabled. Left-click **Create** to create the Virtual Network or left-click **Cancel** to discard the changes. Once the element is created, a new Virtual Network will be displayed in the manager's workspace.

2.1.3.3.2 Deploying a Standard VN

Select the Virtual Network in the workspace to deploy it. To select an element, left-click inside it in the workspace until its border has changed to a dashed pattern of a color different from gray. Once selected, there are two ways to initiate deployment:

- Left-click **Actions** and select **Deploy**.
- Right-click in the previously selected element and select **Deploy** from the list that is displayed.

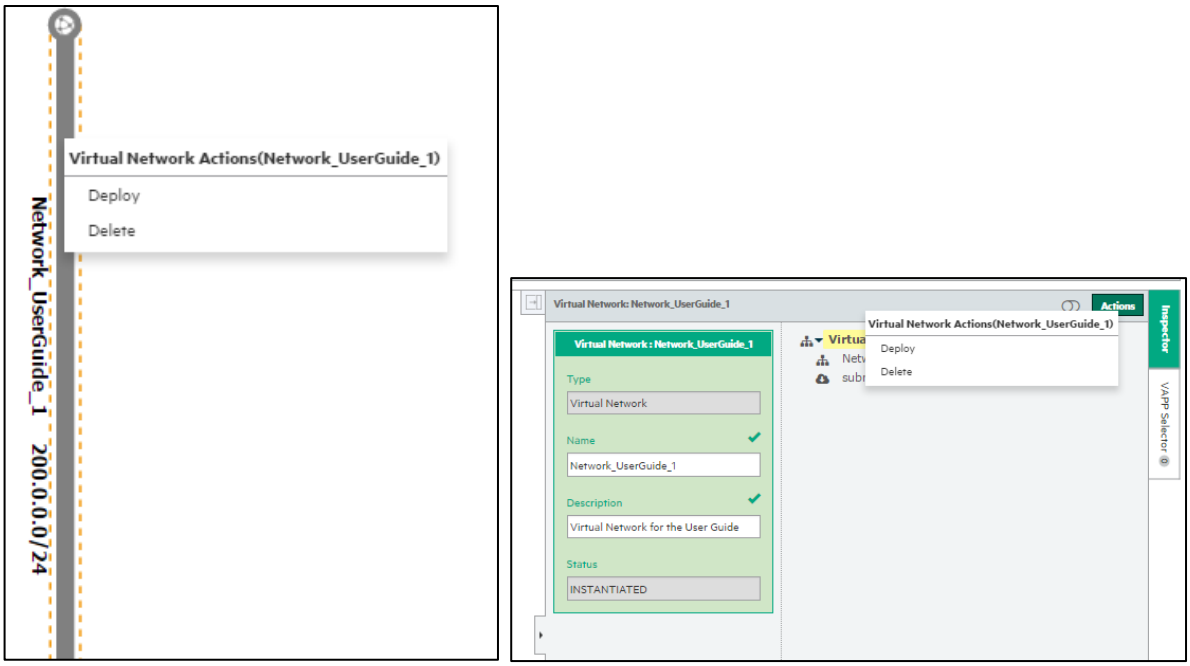


Figure 152: Two ways to launch a Deploy a Standard VN

After the required action has been selected, the **VDC Manager** will display the following window.

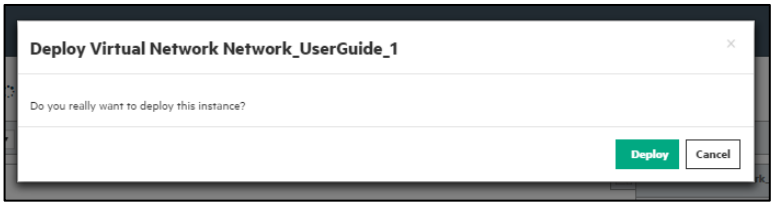


Figure 153: Deploy Virtual Network confirmation window

Left-click **Deploy** to deploy the element. If the deployment process started correctly, the system will display a confirmation message and register in the **Jobs Monitor** similar to the following illustrations.

Click the  button to access these messages.

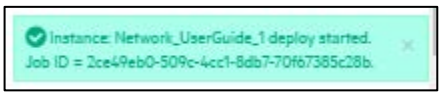


Figure 154: Deploy Virtual Network confirmation message

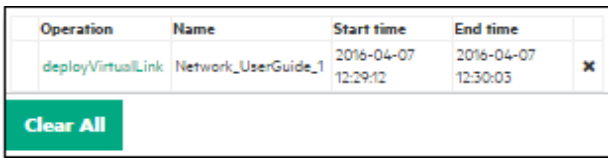


Figure 155: Deploy Virtual Network job registration

If the deployment process ended properly, the color of the element will change to green, indicating **ACTIVE** status. If the color of the element changes to red, it indicates **ERROR** status.

2.1.3.3.3 Deleting a Standard VN

Select a **Virtual Network** in the workspace and left-click inside an element to change its border to a dashed line that is any color but gray. There are two ways to initiate deleting.

- Left-click **Actions** and select **Delete**.
- Right-click inside the previously selected element and select **Delete** from the displayed list.

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 156: Delete Virtual Network confirmation window

Left-click **Delete** to delete the element. If the deleting process started correctly, the system will display a confirmation message similar to the following illustration.

Click the  button to access these messages.

Figure 157: Delete Virtual Network confirmation message

2.1.3.3.4 Un-deploying a Standard VN

The **Un-deploy** operation is only available in the **VDC Manager** is for the selected Virtual Network to have active un-deployed status. Active Virtual Network status is indicated by any color other than gray and red.

There are two ways to initiate un-deployment.

- Right-click the Virtual Network and select **Un-Deploy** from the displayed list.
- Select the Virtual Network, left-click **Actions** at the right side of the **VDC Manager**, and select **Un-Deploy**.

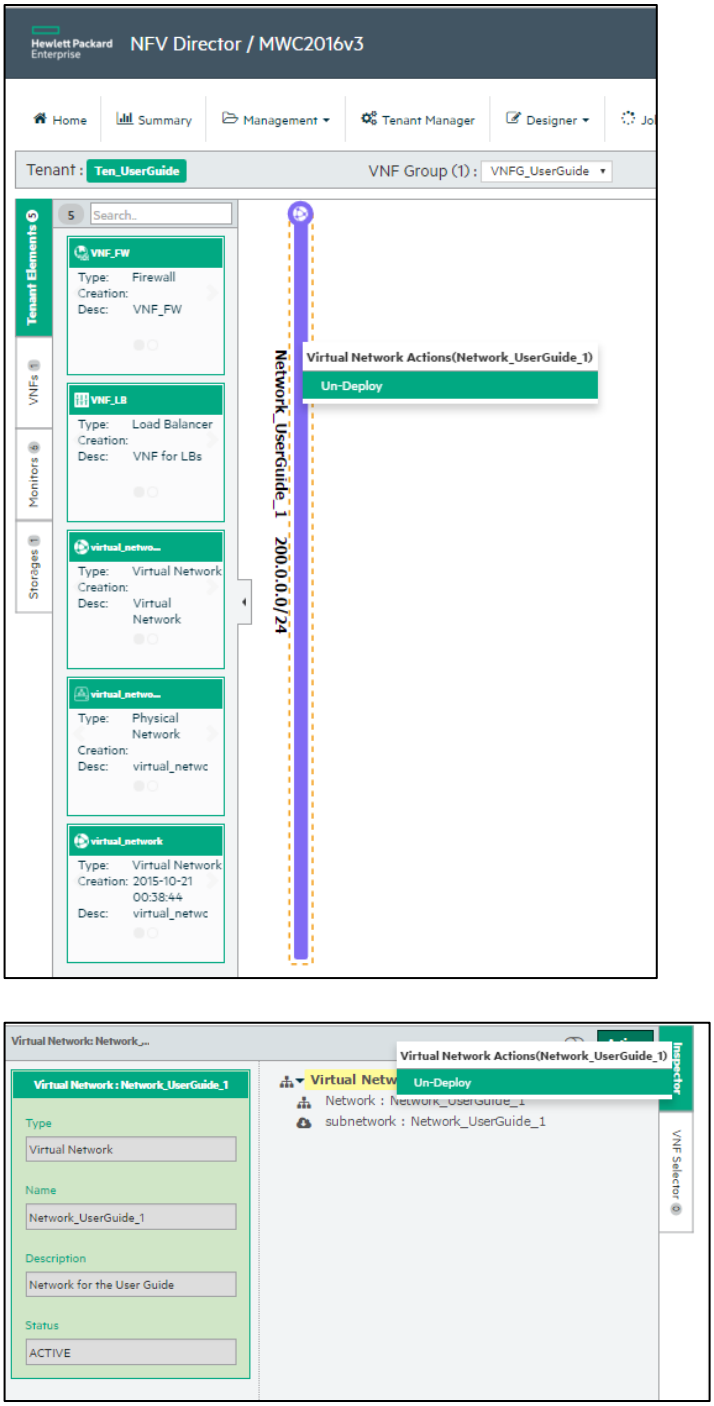


Figure 158: Two ways to initiate un-deployment

After the **Un-deploy** operation has been selected, the following confirmation window will be displayed.

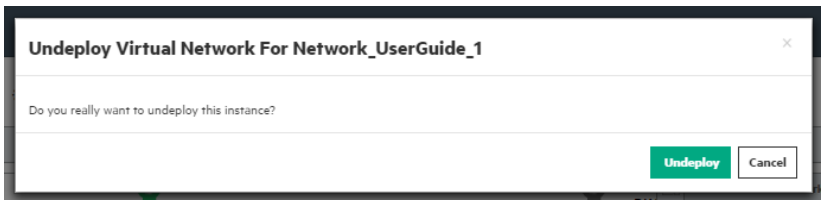


Figure 159: Un-deploy operation confirmation window

If the Virtual Network still has elements connected, the following window will be displayed.

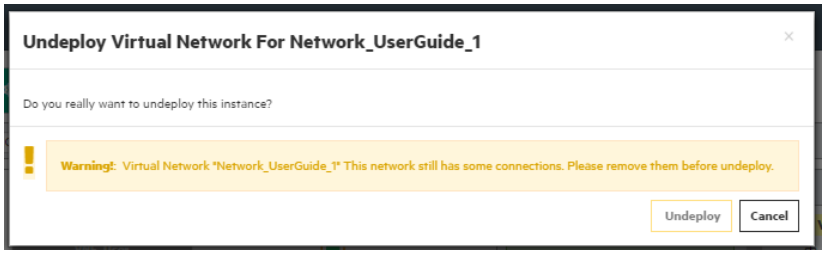


Figure 160: Un-deploy operation connections warning window

In this case all the connections related to the Virtual Network need to be removed before proceeding with un-deployment. Left-click **Un-deploy** to un-deploy the selected Virtual Network or left-click **Cancel** to discard the un-deployment process. If the un-deployment process is executed correctly, the element will be removed from the workspace.

2.1.3.4 Physical Network operations

In order to operate with networks in the **VDC Manager**, left-click in the **VDC Elements** to select the tag. Once the list of elements is loaded, a Virtual Network can be selected to be created in the workspace. There are three types of Virtual Networks suitable for operation. This section will discuss Physical Network operations.

2.1.3.4.1 Creating a Physical VN

The difference between a Standard VM and a Physical VM is that the physical have elements in the real world. The **VDC Manager** treats both the same. There are two ways to create (instantiate) a Physical Virtual Network.

- Select the template from the list and drag it to the workspace.
- Select the element from the list, left-click **Actions** and select **Create** from the displayed list.

When a Virtual Network is selected from the list of components, the component's border color will turn green. The system will also generate the timestamp for the component. These changes are indicated in the following illustration.

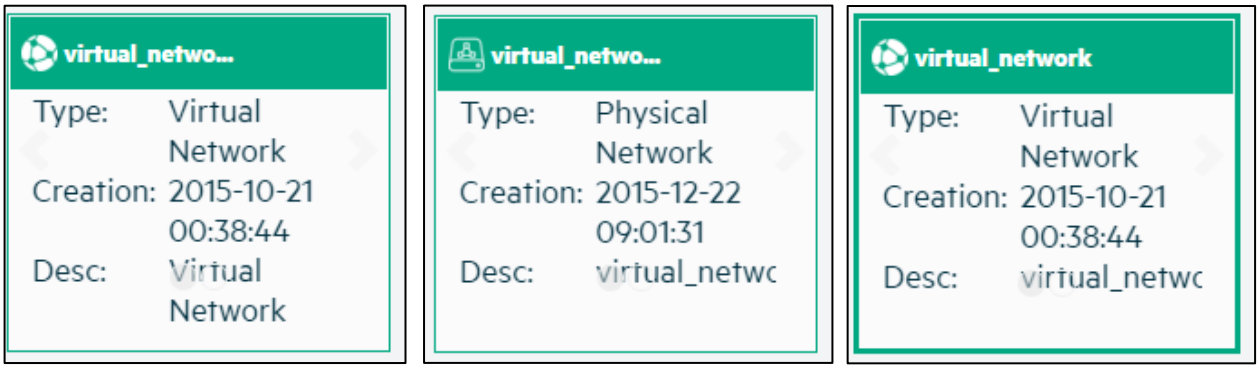


Figure 161: Three types of Virtual Networks

Regardless of the method used to create the instance, the same window will be displayed.

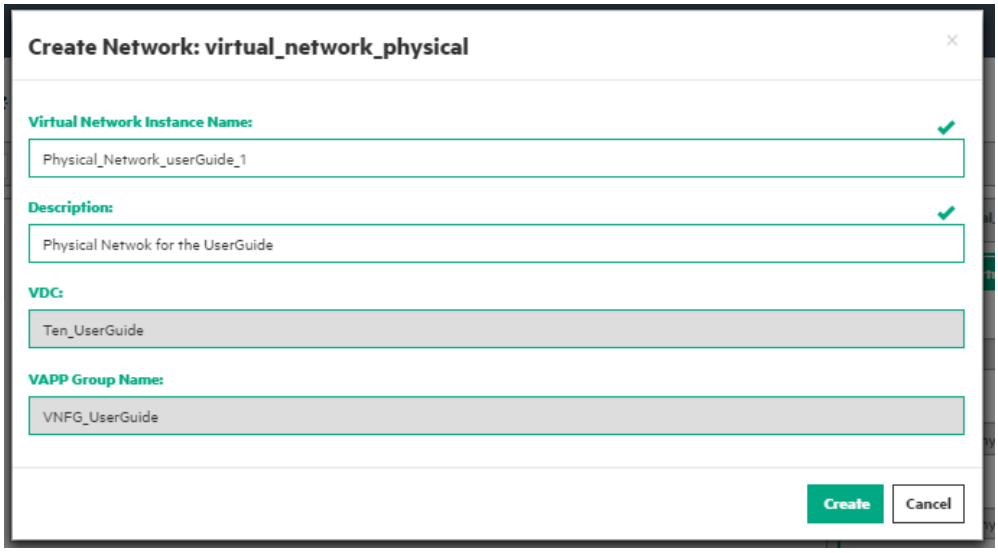


Figure 162: Create Physical VN window

For this Virtual Network example we set the name of the network to **Physical_Network_userGuide_1** and the **Description** field to **Physical Network for the user Guide**. The **VDC** and **VNF Group Name** fields are disabled. Left-click **Create** to create the Physical Network or left-click **Cancel** to discard the changes. Once the element is created, a new Physical Network will be displayed in the manager's workspace.

Creating a Physical Network creates 2 networks with subnetworks.

When using a multi-site solution with SDN and IPAM plugin, make sure that the ranges and mask are the same. If the IPAM is to manage them as a single network, make sure that either **vxlan** or **vlan** subnet IP address does not collide.

One site will be **vxlan** based and will appear at SDN level (if SDN is present). The other site will be **vlan** based and so it will **not** appear in SDN (if SDN is present).

2.1.3.4.2 Deploying a Physical VN

Select the Virtual Network in the workspace to deploy a Physical Virtual Network Standard. To select an element in the workspace, left-click inside it in the workspace until its border has changed to a dashed line any color but gray. Once selected, there are two ways to initiate deployment:

- Left-click **Actions** and select **Deploy**.
- Right-click in the previously selected element and select **Deploy** from the list that is displayed.

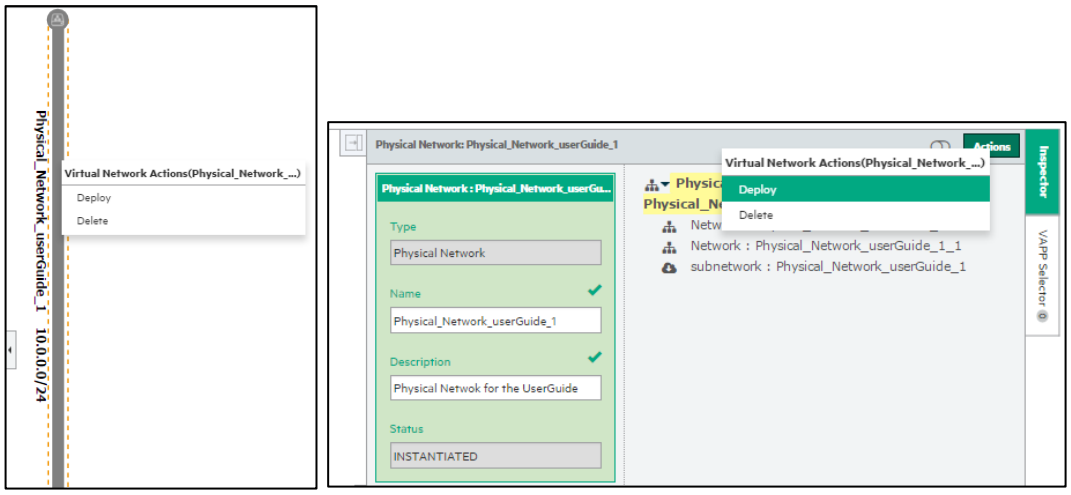


Figure 163: Two ways to launch a Deploy a Physical VN

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 164: Deploy Physical VN confirmation window

Left-click **Deploy** to deploy the element. If the deployment process started correctly, the system will display a confirmation message and register in the **Jobs Monitor** similar to the following illustrations.

Click the  button to access these messages.

Figure 165: Deploy a Physical VN confirmation message

Figure 166: Deploy a Physical VN job registration

If the deployment process ended properly, the color of the element will change to green, indicating **ACTIVE** status. If the color of the element changes to red, it indicates **ERROR** status.

2.1.3.4.3 Deleting a Physical VN

Select the **Virtual Network** in the workspace and left-click inside an element to change its border to a dashed line that is any color but gray. There are two ways to initiate deleting:

- Left-click **Actions** and select **Delete**.
- Right-click inside the previously selected element and select **Delete** from the displayed list.

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 167: Delete Physical VN confirmation window

Left-click **Delete** to delete the element. If the deleting process started correctly, the system will display a confirmation message similar to the following illustration.

Click the  button to access these messages.

Figure 168: Delete Physical VN confirmation message

2.1.3.4.4 Un-deploying a Physical VN

The **Un-deploy** operation is only available in the **VDC Manager**. The selected Physical Virtual Network has to have active un-deployed status. Active Physical Virtual Network status is indicated by any color other than gray and red.

There are two ways to initiate un-deployment.

- Right-click the Physical Virtual Network and select **Un-Deploy** from the displayed list.
- Select the Physical Virtual Network, left-click **Actions** at the right side of the **VDC Manager** and select **Un-Deploy**.

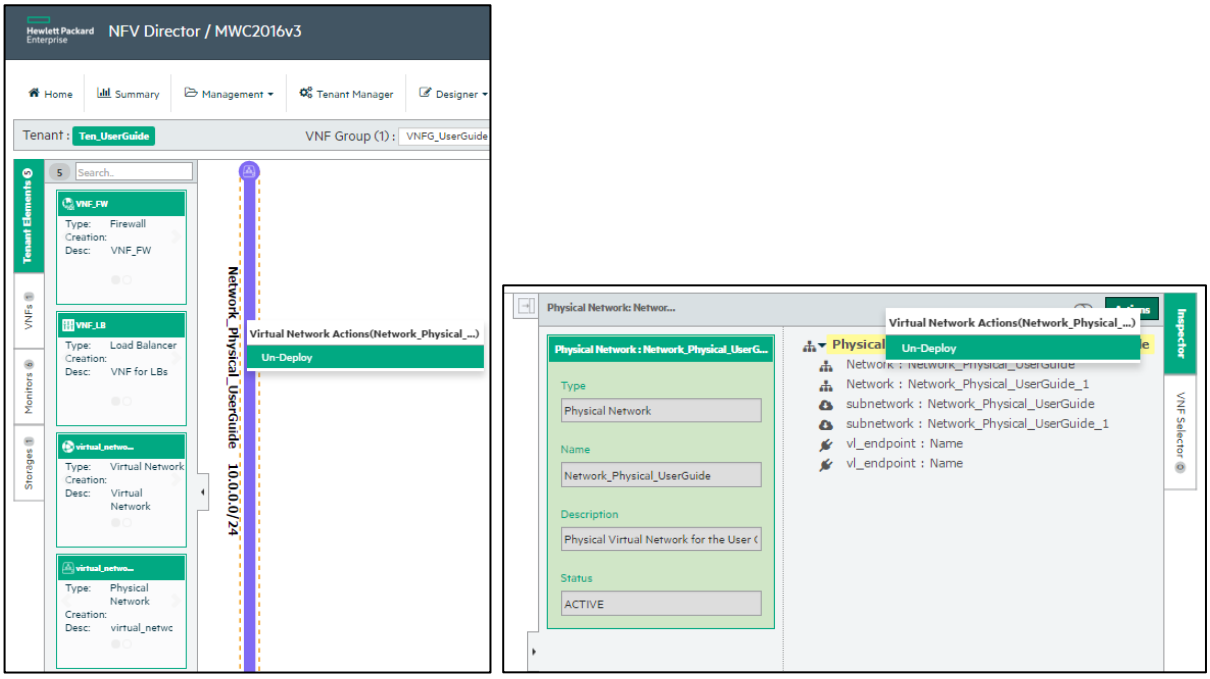


Figure 169: Two ways to initiate un-deployment

After the **Un-deploy** operation has been selected, the following confirmation window will be displayed.

Figure 170: Physical VN un-deploy operation confirmation window

If the Virtual Network still has elements connected, the following window will be displayed.

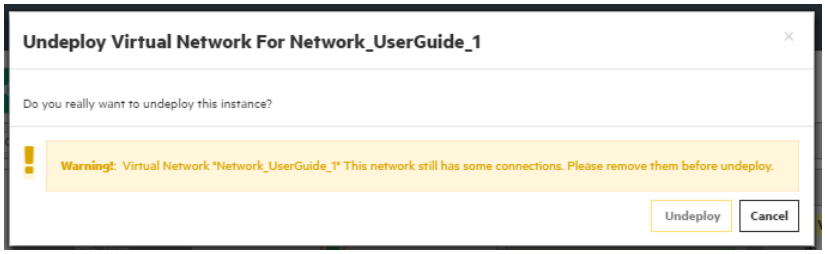


Figure 171: Un-deploy operation connections warning window

In this case all the connections related to the Virtual Network need to be removed before proceeding with un-deployment. Left-click **Un-deploy** to un-deploy the selected Virtual Network or left-click **Cancel** to discard the un-deployment process. If the un-deployment process is executed correctly, the element will be removed from the workspace.

2.1.3.5 Monitored Virtual Network operations

In order to operate with networks in the **VDC Manager**, left-click in the **VDC Elements** to select the tag. Once the list of elements is loaded, a Virtual Network can be selected to be created in the workspace. There are three types of Virtual Networks suitable for operation. This section will discuss Monitored Virtual Network operations.

A Monitored Virtual Network has two previously configured monitors: one for the network itself and another for the subnetwork related to the network, as indicated in the following illustration.

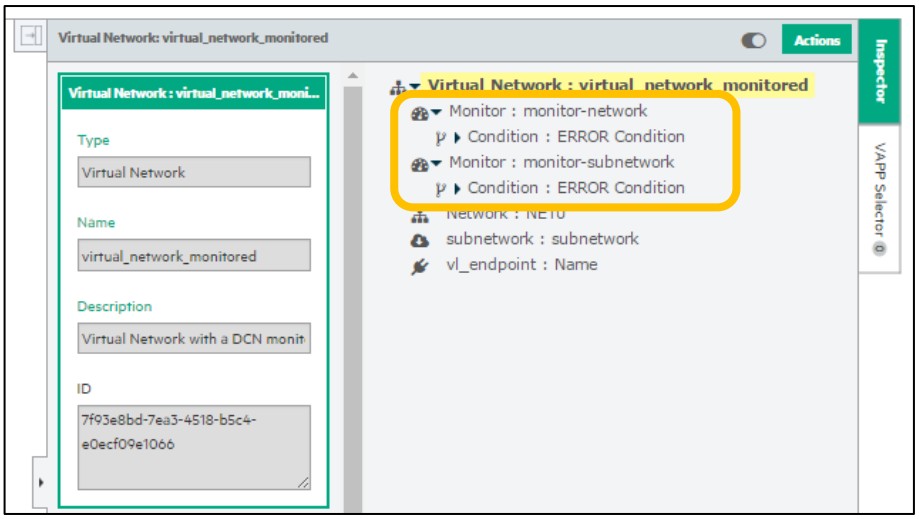


Figure 172: Monitored VN structure

2.1.3.5.1 Creating a Monitored VN

There are two ways to create (instantiate) a Monitored Virtual Network.

- Select the element from the list and drag it to the workspace.
- Select the element from the list, left-click **Actions**, and select **Create** from the displayed list.

When a Monitored Virtual network is selected from the list of components, the component's border color will turn green. The system will also generate the timestamp for the component. These changes are indicated in the following illustration.

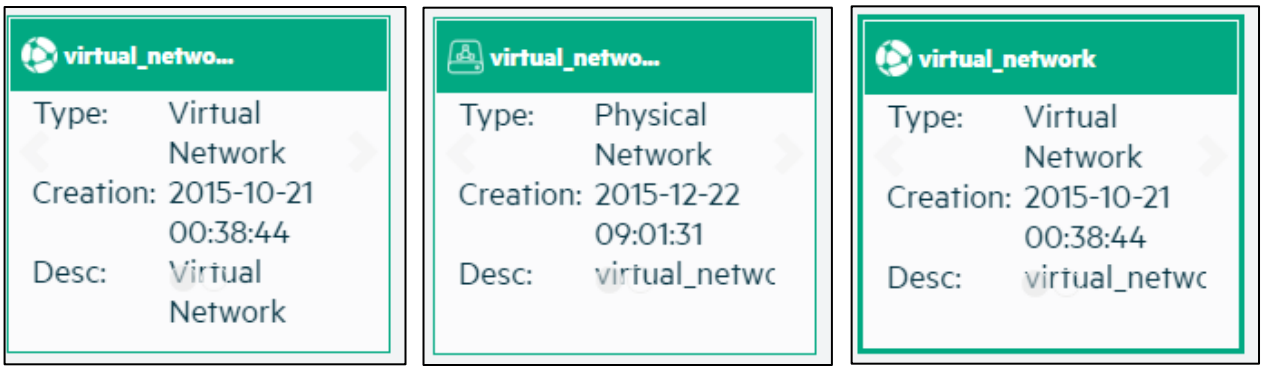


Figure 173: Three types of Virtual Networks

Regardless of the method used to create the instance, the same window will be displayed.

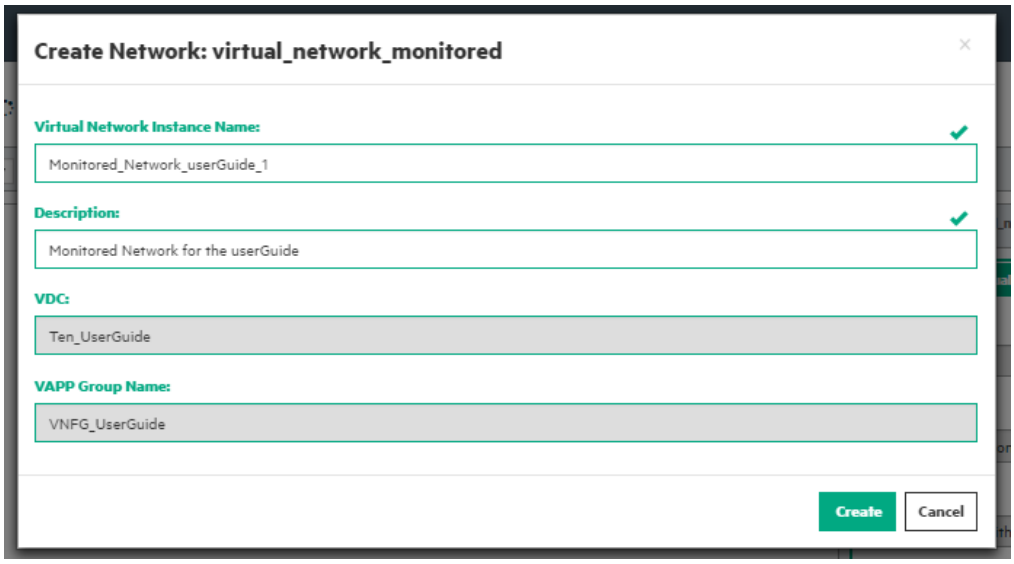


Figure 174: Create Monitored VN window

For this Virtual Network example we set the name of the network to **Monitored_Network_userGuide_1** and the **Description** field to **Monitored Network for the userGuide**. The **VDC** and **VNF Group Name** are disabled. Left-click **Create** to create the Physical Network or left-click **Cancel** to discard the changes. Once the element is created, a new Physical Network will be displayed in the manager's workspace.

2.1.3.5.2 Deploying a Monitored VN

Select the Virtual Network in the workspace to deploy a Monitored Virtual Network. To select an element in the workspace, left-click inside it in the workspace until its border has changed to a dashed line that is any color but gray. Once selected, there are two ways to initiate a deployment:

- Left-click **Actions** and select **Deploy**.
- Right-click in the previously selected element and select **Deploy** from the list that is displayed.

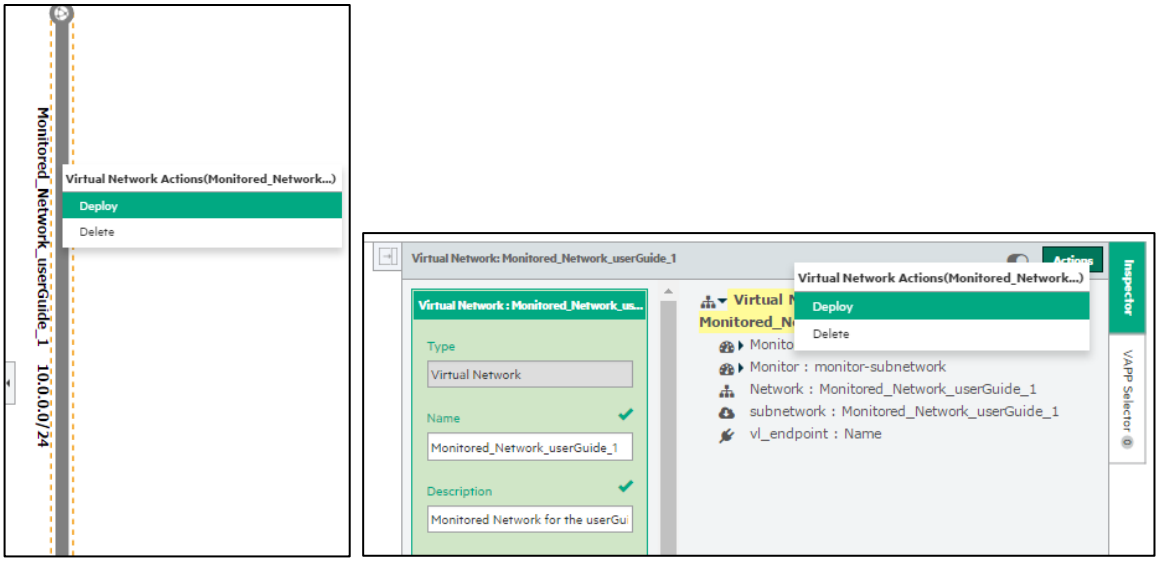


Figure 175: Two ways to launch a Deploy a Monitored VN

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 176: Monitored VN deployment confirmation window

Left-click **Deploy** to deploy the element. If the deployment process started correctly, the system will display a confirmation message and register in the **Jobs Monitor** similar to the following illustrations.

Click the  button to access these messages.

Figure 177: Monitored VN deployment confirmation message

Figure 178: Monitored VN deployment job registration

If the deployment process ended properly, the color of the element will change to green, indicating **ACTIVE** status. If the color of the element changes to red, it indicates **ERROR** status.

2.1.3.5.3 Deleting a Monitored VN

Select the **Virtual Network** in the workspace and left-click inside an element to change its border to a dashed line that is any color but gray. There are two ways to initiate deleting:

- Left-click **Actions** and select **Delete**.
- Right-click inside the previously selected element and select **Delete** from the displayed list.

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 179: Delete Monitored VN confirmation window

Left-click **Delete** to delete the element. If the deleting process started correctly, the system will display a confirmation message similar to the following illustration.

Click the  button to access these messages.

Figure 180: Delete Monitored VN confirmation message

2.1.3.5.4 Un-deploying a Monitored VN

The **Un-deploy** operation is only available in the **VDC Manager**. The selected Monitored Virtual Network needs to have active un-deployed status. Active Monitored Virtual Network status is indicated by any color other than gray and red.

There are two ways to initiate un-deployment.

- Right-click the Monitored Virtual Network and select **Un-Deploy** from the displayed list.
- Select the Monitored Virtual Network, left-click **Actions** at the right side of the **VDC Manager**, and select **Un-Deploy**.

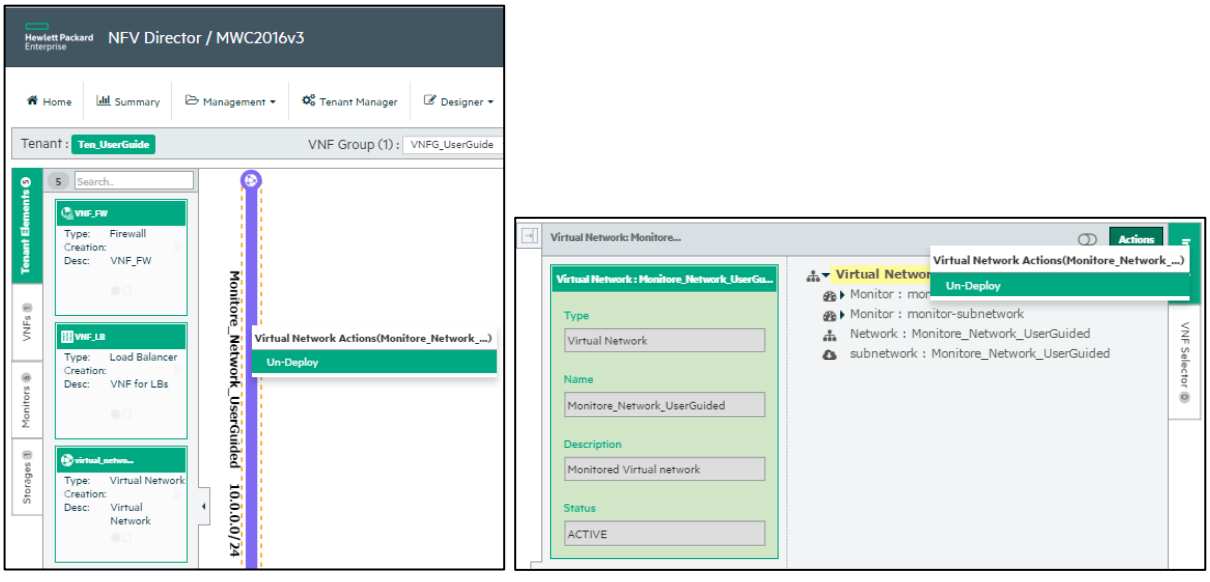


Figure 181: Two ways to initiate un-deployment

After the **Un-deploy** operation has been selected, the following confirmation window will be displayed.

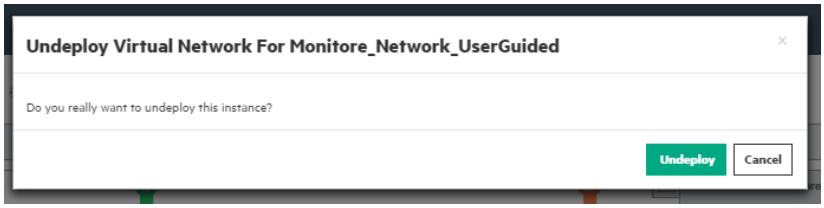


Figure 182: Monitored VN un-deploy operation confirmation window

If the Virtual Network still has elements connected, the following window will be displayed.

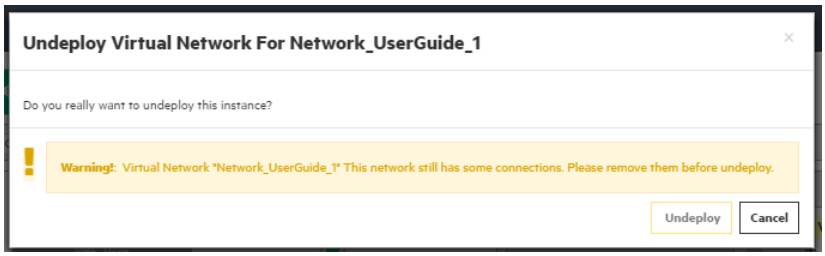


Figure 183: Un-deploy operation connections warning window

In this case all the connections related to the Virtual Network need to be removed before proceeding with un-deployment. Left-click **Un-deploy** to un-deploy the selected Virtual Network or left-click **Cancel** to discard the un-deployment process. If the un-deployment process is executed correctly, the element will be removed from the workspace.

2.1.4 VNF operations

In order to operate with VNFs in the **VDC Manager**, left-click in the **VDC Elements**. Once the list of elements is loaded, a VNF can be selected to be created in the workspace. This is a special type of artifact that develop a complex task in the system. The following sections discuss **VDC Manager** operations with the different types of VNFs available.

Due to the nature of these components, a distinction needs to be made for when the component is in a state other than **ACTIVE**, and when the component has been activated.

2.1.4.1 VNF attributes

The majority of all VNF attributes and categories are similar with small additions or configurations. This section details the specific attributes of the Virtual Networks.

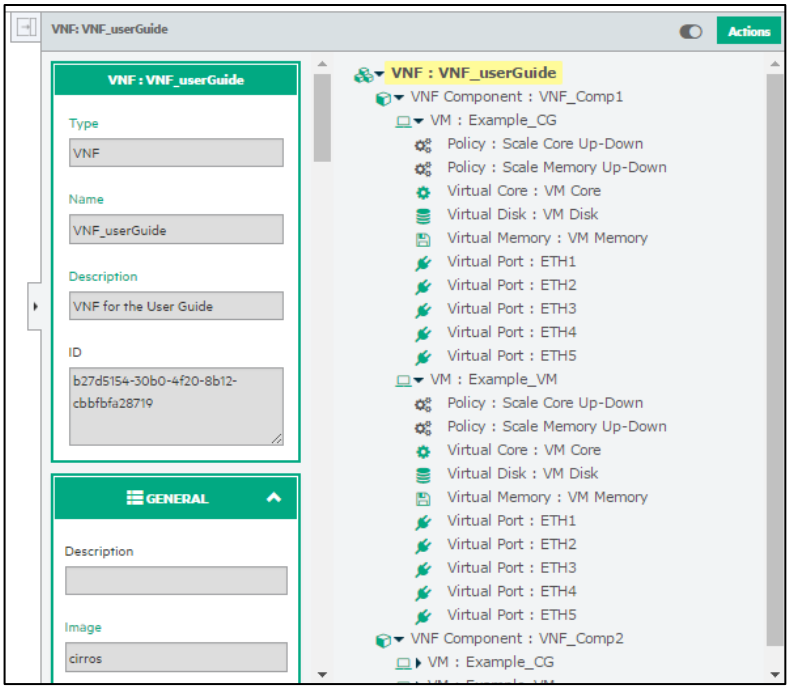


Figure 184: VNF components and attributes

The previous illustration indicates the general attributes of the **VNF_userGuide**. In this case the **Type** and **Status** attributes cannot be edited. The **ID** field, for obvious reasons, is also disabled. The values for the **Name** and **Description** fields are **VNF_userGuide** and **VNF designed by the user**. Left-click in these fields to edit their values.

These attributes are common to all VNFs. A VNF can have a wide range of components and configurations. In order to provide appropriate editing support, the following sections will explain a significant sample of the possibilities.

There are special, more complex VNFs. An example is the **VNF Firewall** with a specific function. This element has attributes besides the ones that are common to all the VNFs.

2.1.4.1.1 VNF Firewall attributes

The **VNF Firewall** is a special type of VNF with a number of requirements. The most important requirement is that the **VNF Firewall** can only be deployed in a Datacenter/Scenario that can operate in a DCN platform. This means that the entire structure required for this platform should be present in the Datacenter to be used. Also, the **VNF Firewall** will use a Service Network to carry out its tasks. This Service Network is neither the External Network, nor the Management Network. These three networks must not be misinterpreted.

IMPORTANT: The **VNF Firewall** must be deployed in a Datacenter/Scenario where DCN is configured.

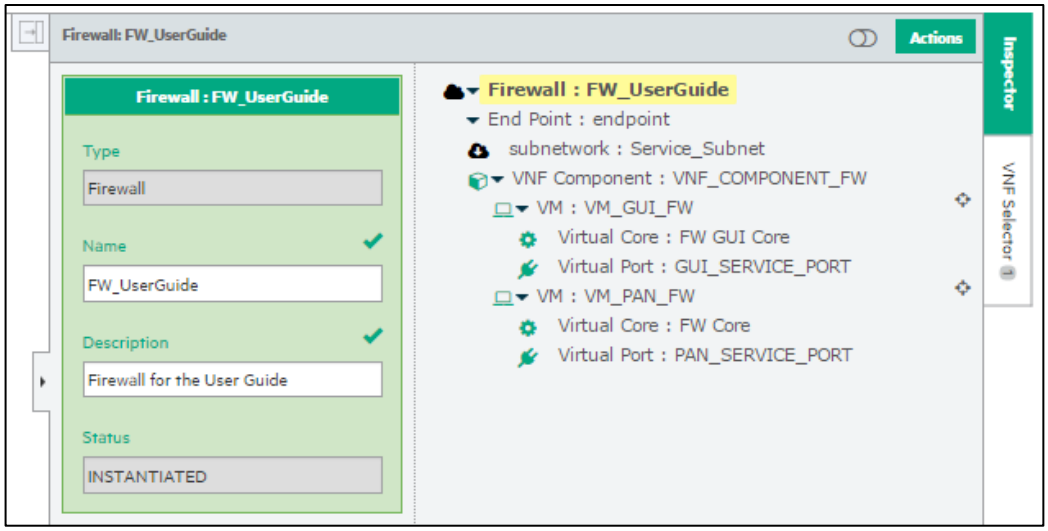


Figure 185: VNF Firewall attributes

The previous illustration indicates, with the **VNF Firewall** selected, all the components that make up the VNF. As indicated, the Firewall has one **Network**, one **Subnetwork**, and an **EndPoint**. It also has a **VNF_Component** that includes two **Virtual Machines**. The **Network** and **Subnetwork** artifacts and possible Virtual Network configurations were explained in previous chapters.

The **EndPoints** are elements of connection between entities. They represent the component point of access when an element or component in the workspace (VDC) tries to communicate with a specific component. This communication will take place through the **EndPoint**, so the **EndPoints** will be connected to the entities required during activation. This refers to communication, not network traffic.

The **Virtual Machine** component attributes will be explained in the *Virtual Machine operations* section. The VNF attributes are the attributes of its components, but only some of them are user-editable.

As indicated on the previous illustration, the **VNF Firewall** has two **Virtual Machines**, the **VM_GUI_FW** and the **VM_PAN_FW**. All Virtual Machines have four user-configurable elements:

- a virtual core
- virtual disk
- virtual memory
- virtual port

The most relevant **VNF Firewall** configuration at this level is the image to be used with the **Virtual Machines**.

Left-click the **Virtual Machine** (PAN or GUI) in the components menu to configure its attributes. Select the **GENERAL** category and assign the correct values to the **Image** and **Type** fields. The **Image** attribute validates the Name. The most often used **Image** value is **cirros**. If **cirros** is selected, **Type** will be **KVM**. Depending on the version, **KVM** images are associated with `.qcow` or `.qcow2` files. Before deployment, a **VNF Firewall** will always check the component image file configuration. Deployment will fail if the image or extension file is not configured correctly.

2.1.4.2 Non-active VNF Firewall operations

The following non-active **VNF:FW** operations are available from the **VDC Manager**:

- creating
- deploying
- deleting

After the component has been activated, the **VDC Manger** allows the following additional operations:

- scaling
- un-deploying

2.1.4.2.1 Creating a VNF Firewall

There are two ways to create (instantiate) a VNF Firewall.

a. Select the element in the list and drag it to the workspace.
b. Select the element in the list, left-click **Actions**, and select **Create** in the displayed list.

When **VNF:FW** is selected from the list of components, the component's border color will turn green. The system will also generate the timestamp for the component. These changes are indicated in the following illustration.

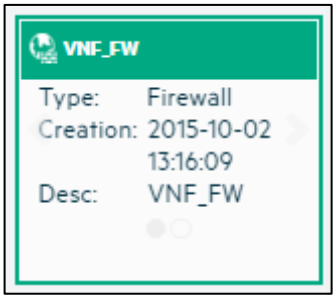


Figure 186: Firewall element in the VDC menu

Regardless of the method used to create the instance, the same window will be displayed.

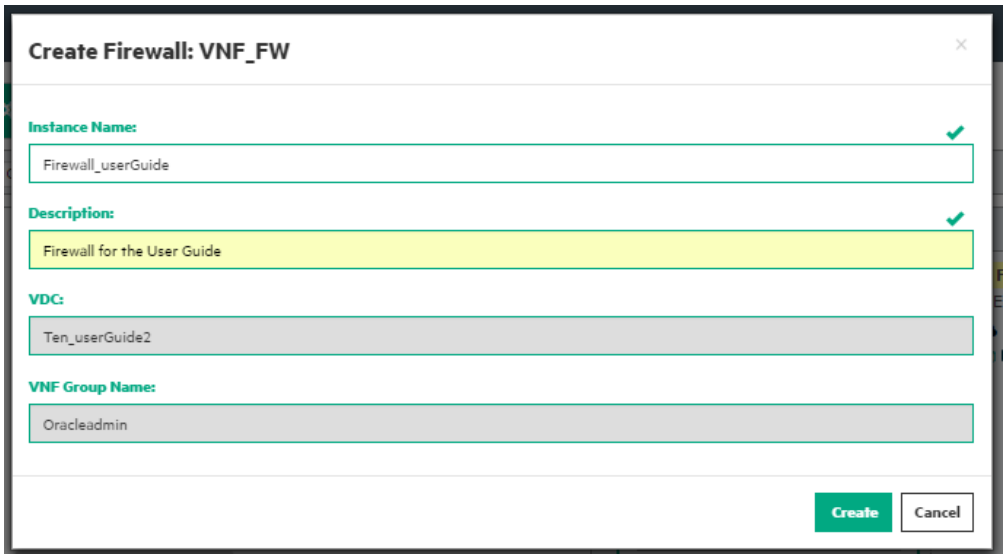


Figure 187: Creating a VNF Firewall

For this **VNF:FW** we set the name of the firewall to **Firewall_userGuide** and the **Description** field to **Firewall for the User Guide**. The **VDC** and **VNFG Group Name** fields are disabled. Left-click **Create** to create the **VNF:FW** or left-click **Cancel** to discard the changes. Once the element is created, a new **VNF:FW** will be displayed in the manager's workspace.

A **Firewall** is a specific implementation of VNF that contains a service network. When using a multi-site solution with IPAM plugin, make sure that the **SERVICE** subnetwork range does not overlap with existing ones.

If the creating process was successful, the system will display a confirmation message similar to the following illustration. Click the  button to access these messages.

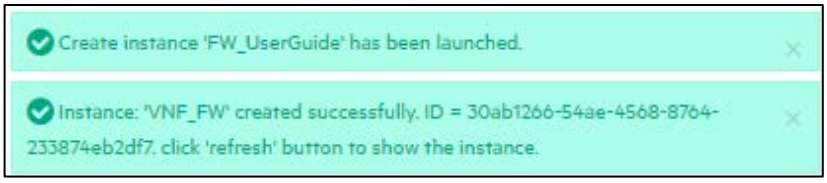


Figure 188: Successful VNF Firewall creation confirmation window

2.1.4.2.2 Deploying a VNF Firewall

Select **VNF:FW** in the workspace to deploy a VNF Firewall. To select an element in the workspace, left-click it in the workspace until its border has changed to a dashed line that is any color but grey. Once selected, there are two ways to initiate deployment:

- Left-click **Actions** and select **Deploy**.
- Right-click in the previously selected element and select **Deploy** from the list that is displayed.

A successful Firewall deployment requires connection to at least two active Virtual Networks. The Firewall could be connected to more than two networks, but two are used for simplicity.

There are two ways to connect the **VNF:FW** to the Virtual Networks.

- Select and right-click the **VNF:FW** in the workspace, and left-click **Connect** from the menu.
- Left-click **Actions** and select **Connect**.

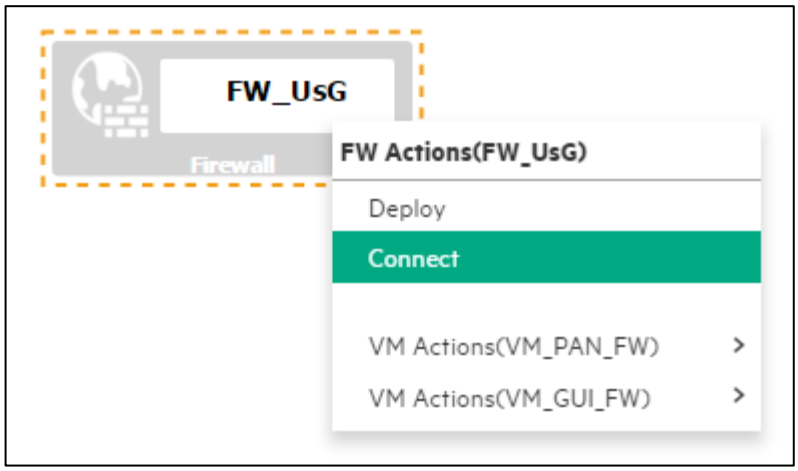


Figure 189: VNF Firewall connect menu

A window similar to the one in the following illustration will be displayed.

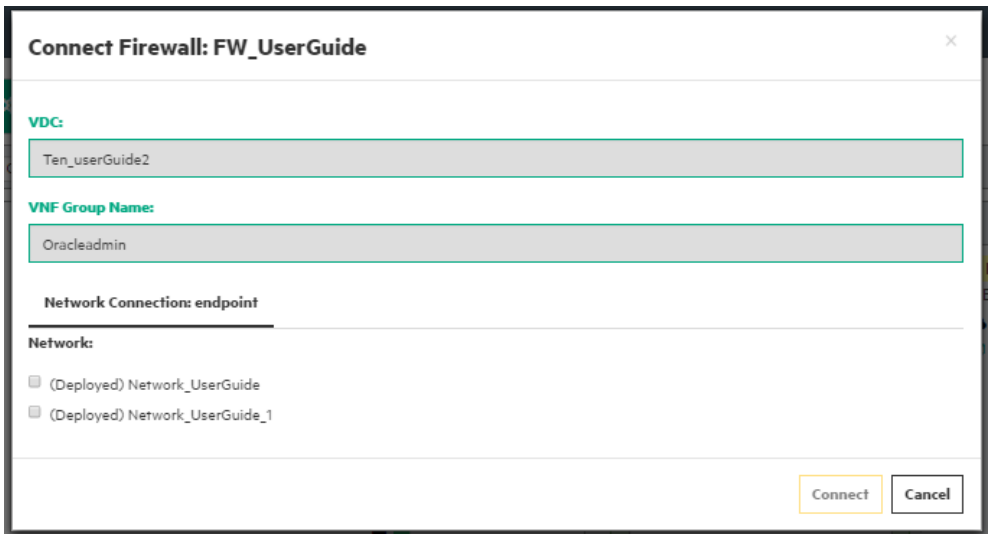


Figure 190: VNF Firewall connection to Virtual Networks form

In order to connect the **VNF:FW** to the Virtual Networks, left-click the checkboxes for the deployed Virtual Networks. Once both **Network_UserGuide** and **Network_UserGuide_1** active Virtual Networks are connected, two lines between each network and the **VNF:FW** will indicate the connections. The lines should be dashed to indicate that the connection exists but it is still in an instantiated status. If the workspace is similar to the one in the following illustration, then the **VNF:FW** will be ready for deployment.

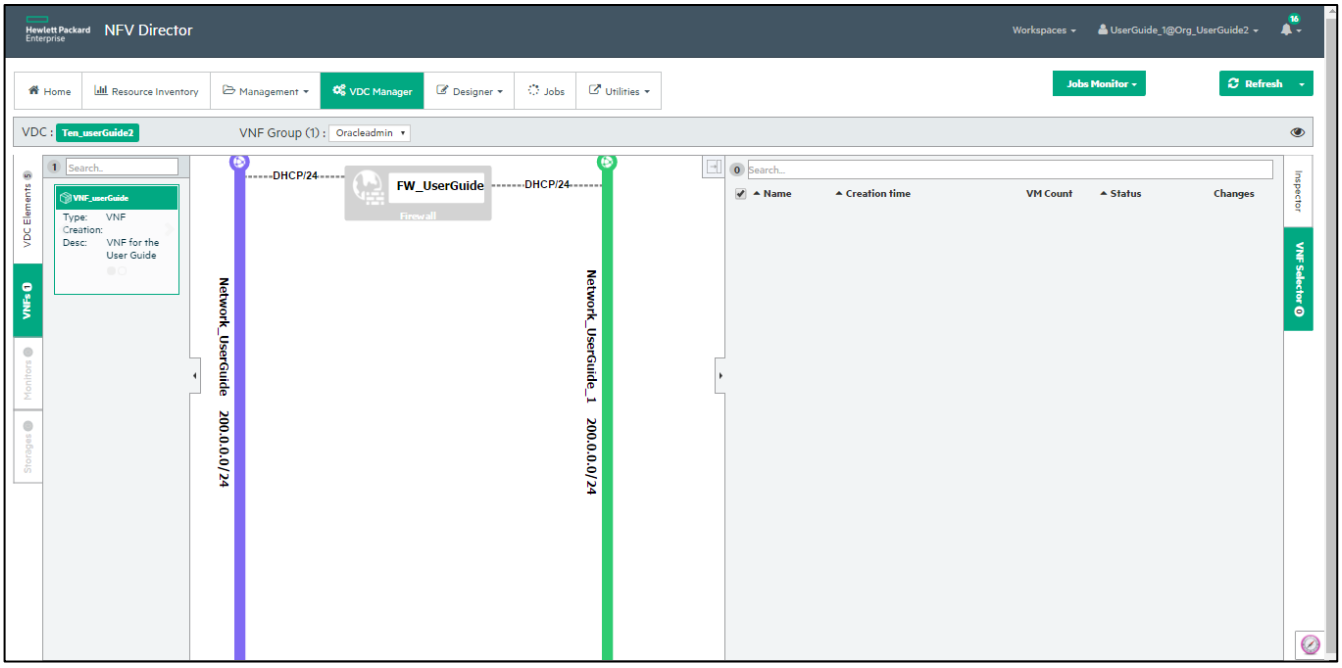


Figure 191: Virtual Networks in the VDC

IMPORTANT: The VNF Firewall must be deployed in a Datacenter/Scenario where DCN is configured.

There are two ways to select deployment and display the following illustration:

- Right-click the component in the workspace and select **Deploy**.
- Left-click **Actions** and select **Deploy**.

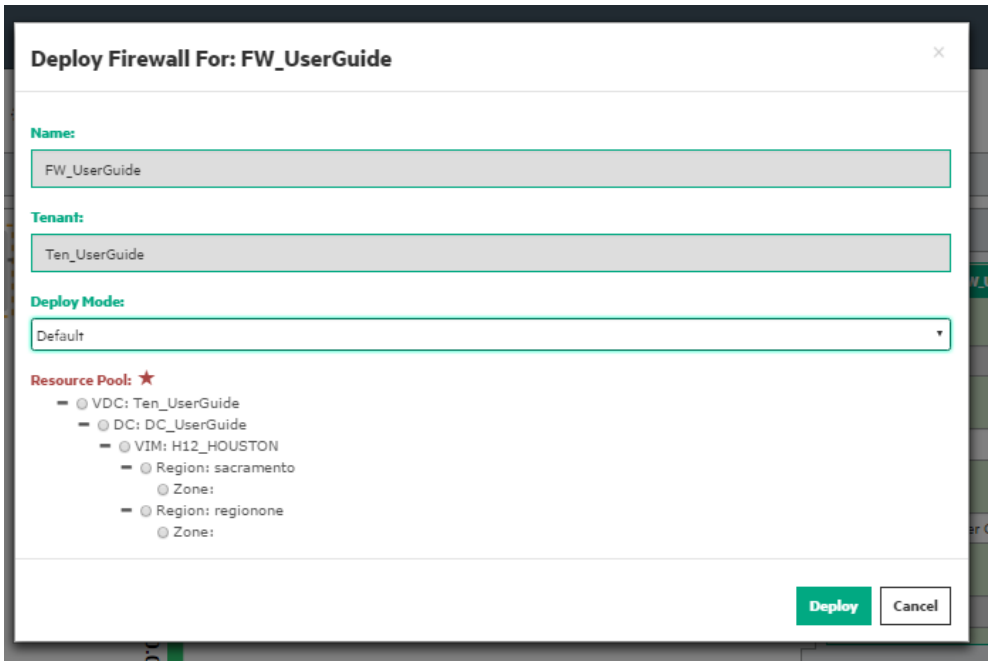


Figure 192: Deploy VNF Firewall confirmation window

The only deployment mode available for **VNF:FW** is **Default**, which executes the actions for each step of the deployment operation without ensuring or simulating the result. The results depend on the **VNF:FW** configuration and the scenario.

After selecting the mode, select the Firewall deployment destination. There is no level restriction for VNF deployment in the selected resource pool. It is enough to select one of the elements in the resource pool list. **Region: regionone→Zone:** is selected for this particular firewall.

Left-click **Deploy** to deploy the element. If the deployment process started correctly, the system will display a confirmation message and register in the **Jobs Monitor** similar to the following illustrations.

Click the  button to access these messages.

Figure 193: Firewall deployment confirmation message

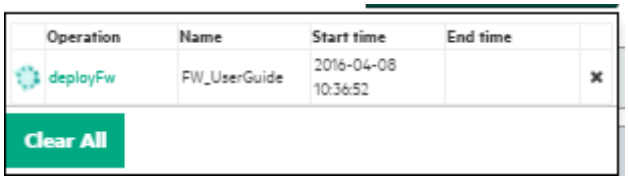


Figure 194: Firewall deployment job registration

If the deployment process ended properly, the color of the element will change to green, indicating **ACTIVE** status. If the color of the element changes to red, it indicates **ERROR** status. If the deployment process was not able to activate the element, the components in the workspace at the end of the process should be in the same state as prior to deployment.

NOTE: If there is a VDC with Management, the VNF will automatically connect to the management network after deployment of the VNF.

2.1.4.2.3 Deleting a VNF Firewall

Select the **VNF Firewall** in the workspace and left-click inside an element to change its border to a dashed line that is any color but gray. There are two ways to initiate deleting.

- Left-click **Actions** and select **Delete**.
- Right-click inside the previously selected element and select **Delete** from the displayed list.

After the required action has been selected, the **VDC Manager** will display the following window:

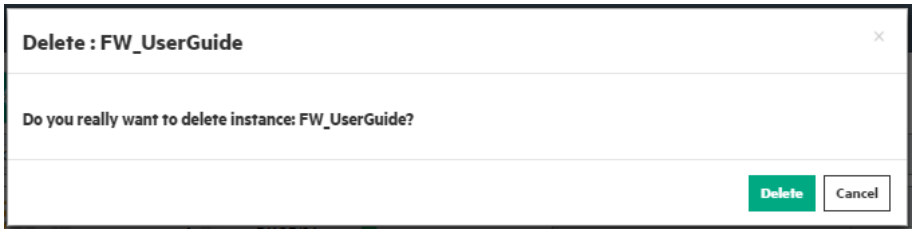


Figure 195: Delete VNF Firewall confirmation window

Left-click **Delete** to delete the element. If the deleting process started correctly, the system will display a confirmation message.

Click the  button to access these messages.

2.1.4.3 Activated VNF Firewall operations

The following **VNF Firewall** operations are available:

- Scale Up
- Scale Down

- Scale In
- Scale Out
- Un-Deploy
- Apply changes
- Connect
- Delete
- Launch Firewall Console

The **Scale** operations can only have one element as target. Each element requires a policy, meaning the VNF Components and the VNF each require a Scale policy in order to escalate. If a policy needs to elevate more than one element, it will only scale one, leaving the others unaltered.

2.1.4.3.1 Un-deploying a VNF Firewall

The **Un-deploy** operation is only available if the specific **VNF Firewall** has **ACTIVE** status. There are two ways to initiate un-deployment.

- Right-click the element and select **Un-Deploy** from the displayed list.
- Select the element in the workspace, left-click **Actions**, and select **Un-Deploy**.

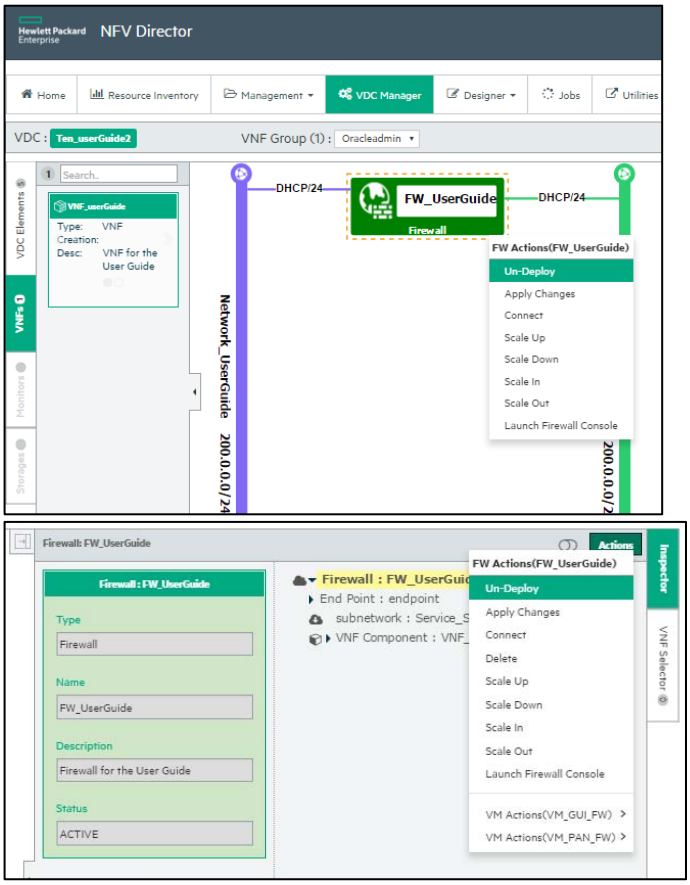


Figure 196: Two ways to initiate un-deployment

After the **Un-deploy** operation has been selected, the following confirmation window will be displayed.

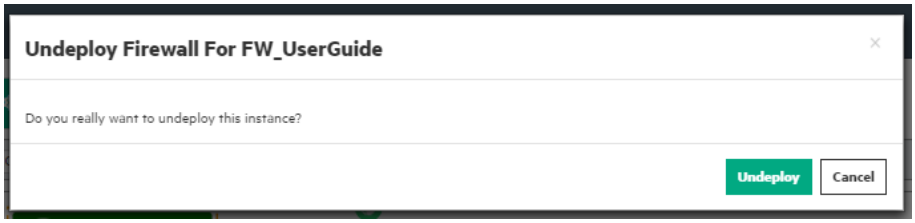


Figure 197: Un-deploy operation confirmation window

For this component the user need to select which is going to be the mode of the deployment process, in this case the user has chosen “Default”, the other mode available is “Guaranteed”,

Left-click **Un-deploy** to un-deploy the selected VNF Firewall or left-click **Cancel** to discard the un-deployment process. If the un-deployment process is executed correctly, the element will be removed from the workspace.

2.1.4.3.2 Scale Up a VNF Firewall

If execution requires a **Scale Up** operation, it can be selected from the list of operations. There are two ways to launch a **Scale Up** operation from the component.

- Right-click in the VNF Firewall in the workspace and select **Scale Up**.
- Left-click **Actions** and select **Scale Up**.

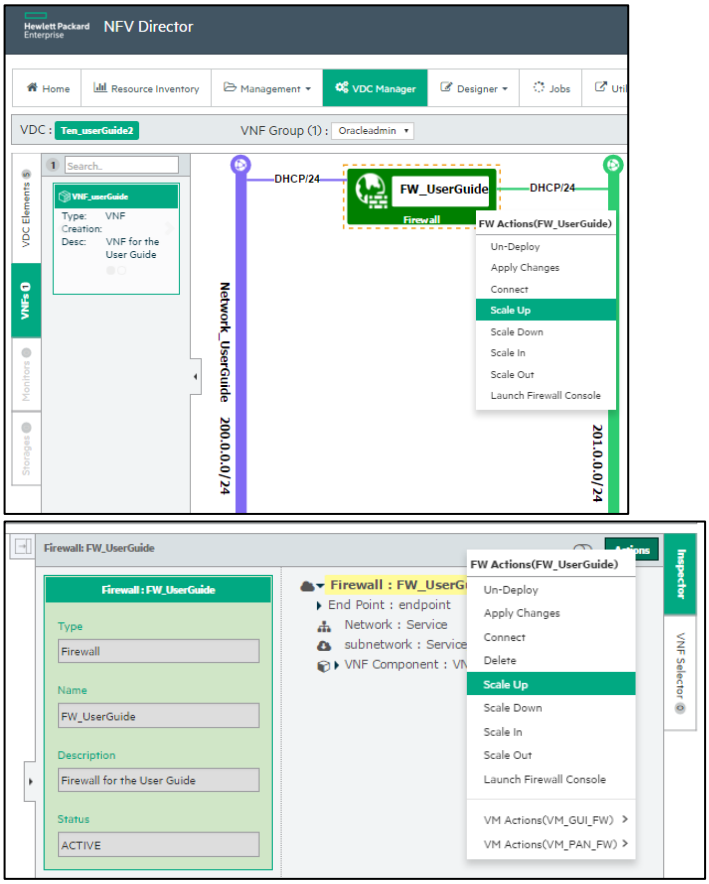


Figure 198: Two ways to Scale Up an activated VNF Firewall

After the operation has been selected, the following confirmation window will be displayed.

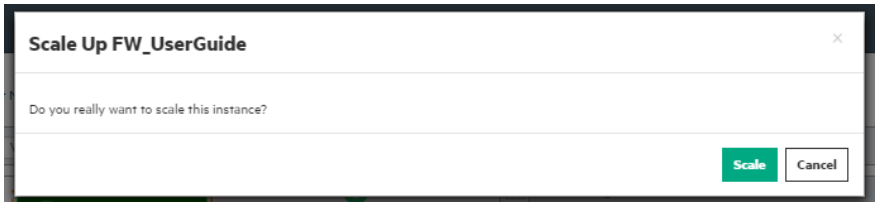


Figure 199: Scale Up an activated VNF Firewall confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.3.3 Scale Down a VNF Firewall

If execution requires a **Scale Down** operation, it can be selected from the list operations. There are two ways to launch a **Scale Down** operation from the component.

- Right-click in the VNF Firewall in the workspace and select **Scale Down**.
- Left-click **Actions** and select **Scale Down**.

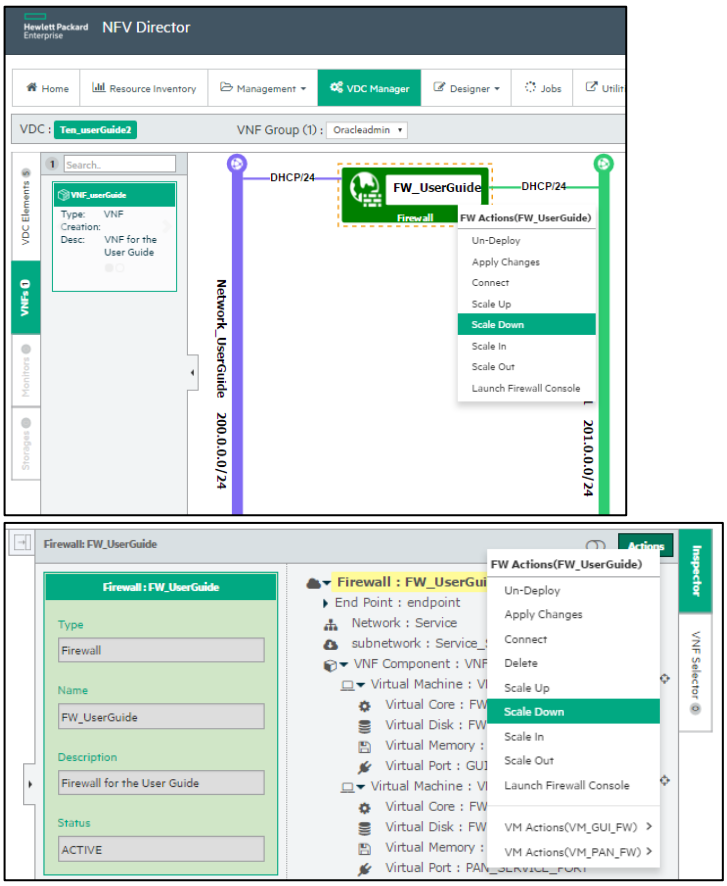


Figure 200: Two ways to Scale Down an activated VNF Firewall

After the operation has been selected, the following confirmation window will be displayed.

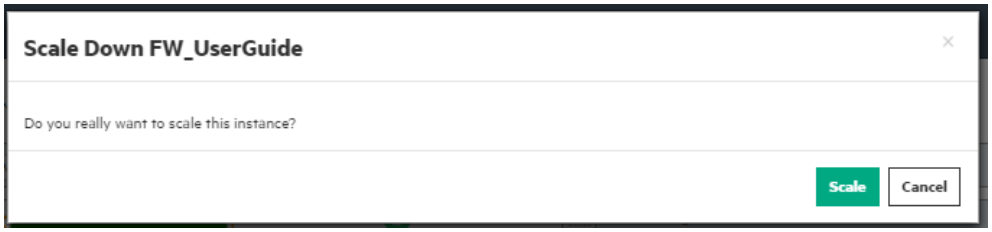


Figure 201: Scale Down an activated VNF Firewall confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.3.4 Scale In a VNF Firewall

If execution requires a **Scale In** operation, it can be selected from the list of operations. There are two ways to launch a **Scale In** operation from the component.

- Right-click in the VNF Firewall in the workspace and select **Scale In**.
- Left-click **Actions** and select **Scale In**.

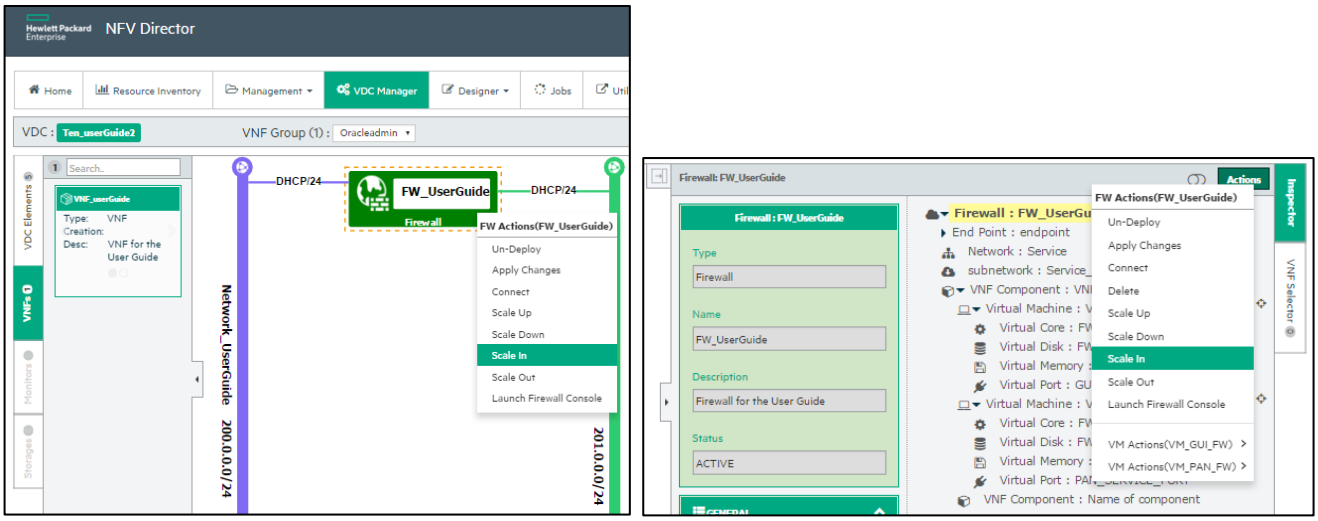


Figure 202: Two ways to Scale In an activated VNF Firewall

After the operation has been selected, the following confirmation window will be displayed.

Figure 203: Scale In an activated VNF Firewall confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.3.5 Scale Out a VNF Firewall

If execution requires a **Scale Out** operation, it can be selected from the list of operations. There are two ways to launch a **Scale Out** operation from the component.

- Right-click in the VNF Firewall in the workspace and select **Scale Out**.
- Left-click **Actions** and select **Scale Out**.

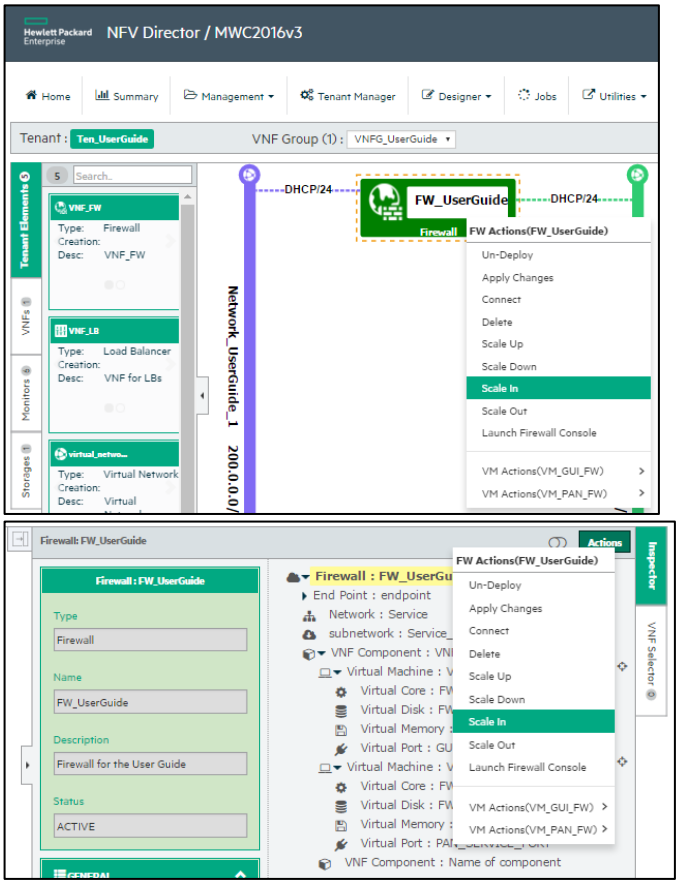


Figure 204: Two ways to Scale Out an activated VNF Firewall

After the operation has been selected, the following confirmation window will be displayed.

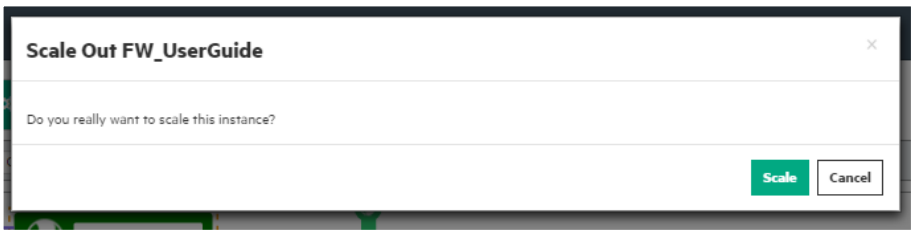


Figure 205: Scale Out an activated VNF Firewall confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.3.6 Launch Firewall console

Select the **Launch Firewall Console** if execution requires the **Firewall Console**. There are two ways to launch a **Firewall Console** from the component.

- Right-click in the VNF Firewall present in the workspace, and select **Launch Firewall Console**.
- Left-click **Actions** and select **Launch Firewall Console**.

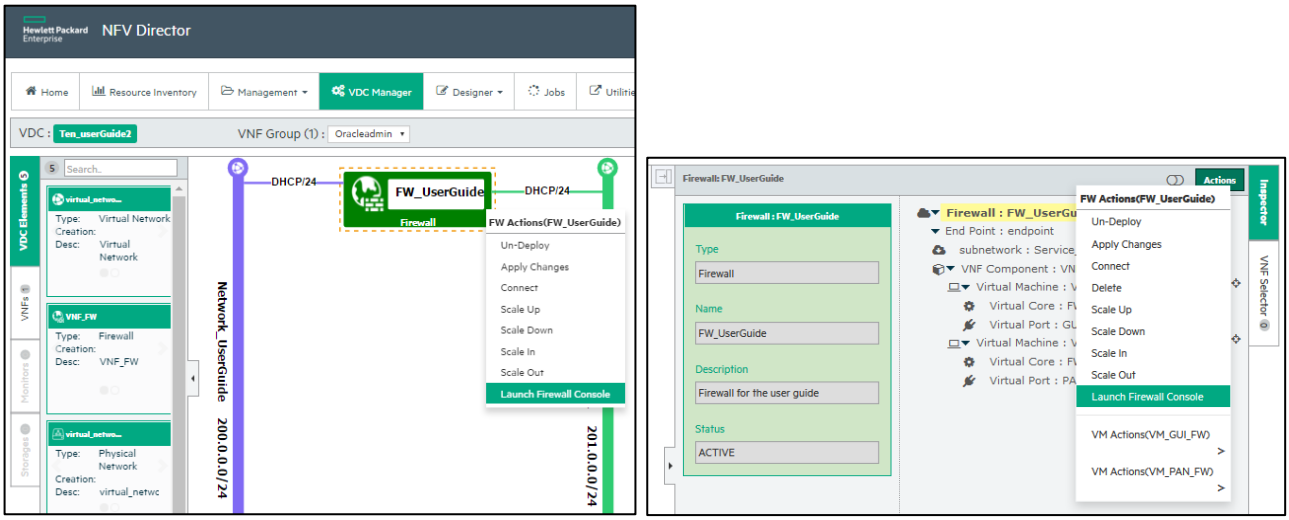


Figure 206: Two ways to launch the Firewall Console

If the console started correctly, the system will display a message to confirm the start of deleting. Click the  button to access these messages. The console will be displayed in a new web page and should be similar to the following illustration.

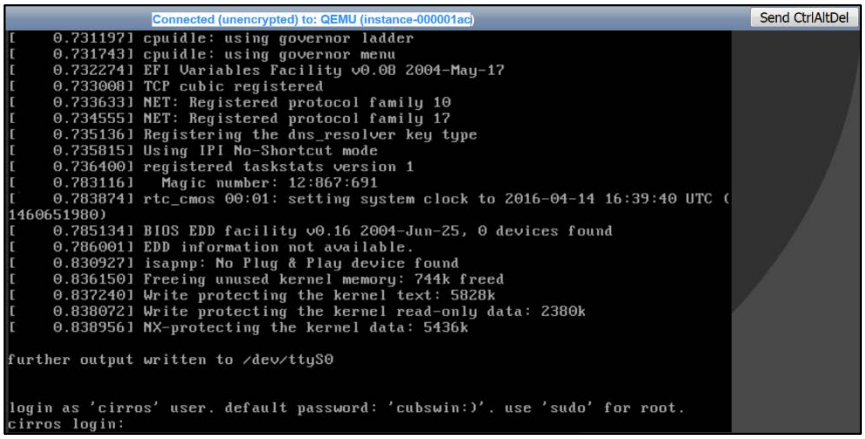


Figure 207: VNF Firewall Console

2.1.4.1 User-created VNF operations

The following non-active user-created VNF operations are available from the **VDC Manager**.

- creating
- deploying
- deleting

After the component has been activated, the **VDC Manager** allows the following additional operations:

- scaling

- un-deploying

also all the operations derivate of each component member of the VNF.

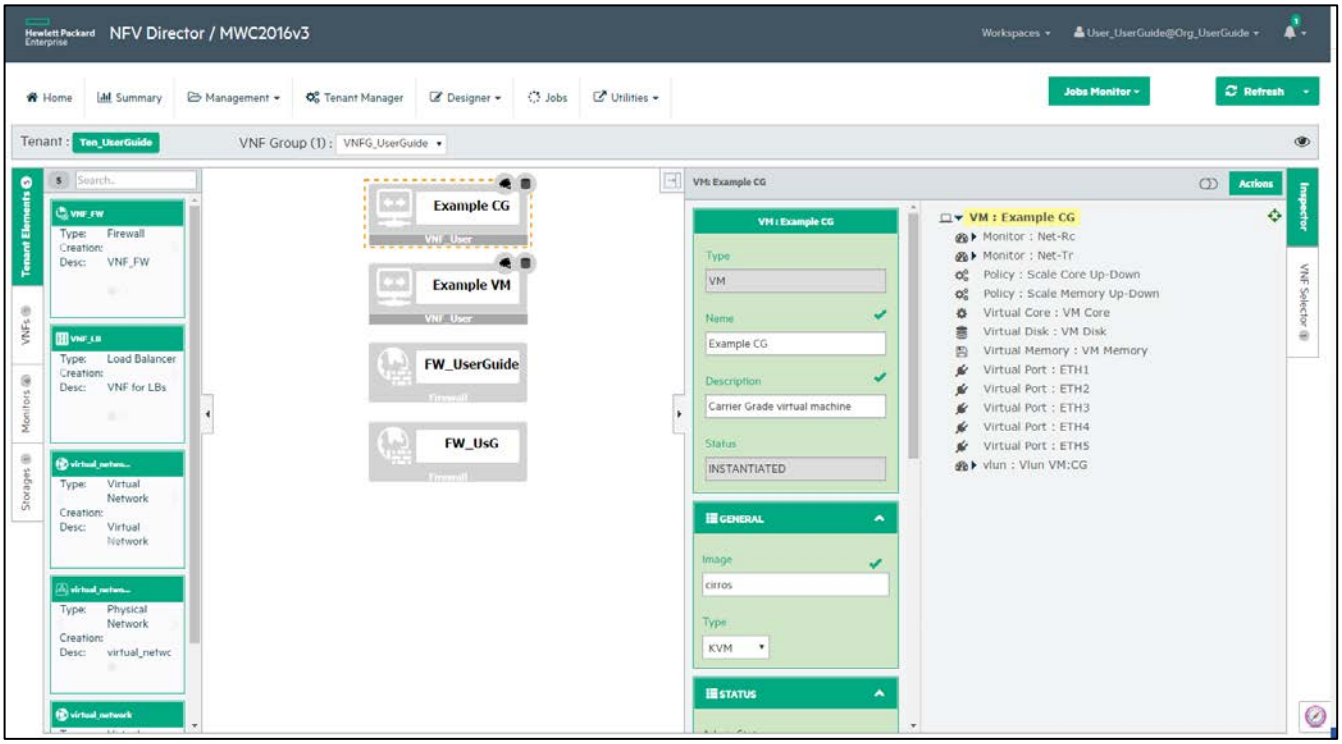


Figure 208: VDC Manager workspace with the three types of VNF

As indicated in the previous illustration, in case of user-created VNF, the workspace displays not only the VNF, but the VNF's Virtual Machine member as well. In this case the selected Virtual Machine is **Example CG**. All elements of this Virtual Machine are displayed and editable by selecting them from the list of components at the right side of the **VDC Manager**.

As indicated in the following illustration, the operations available for this component are the same as those available for the rest of the VNF.

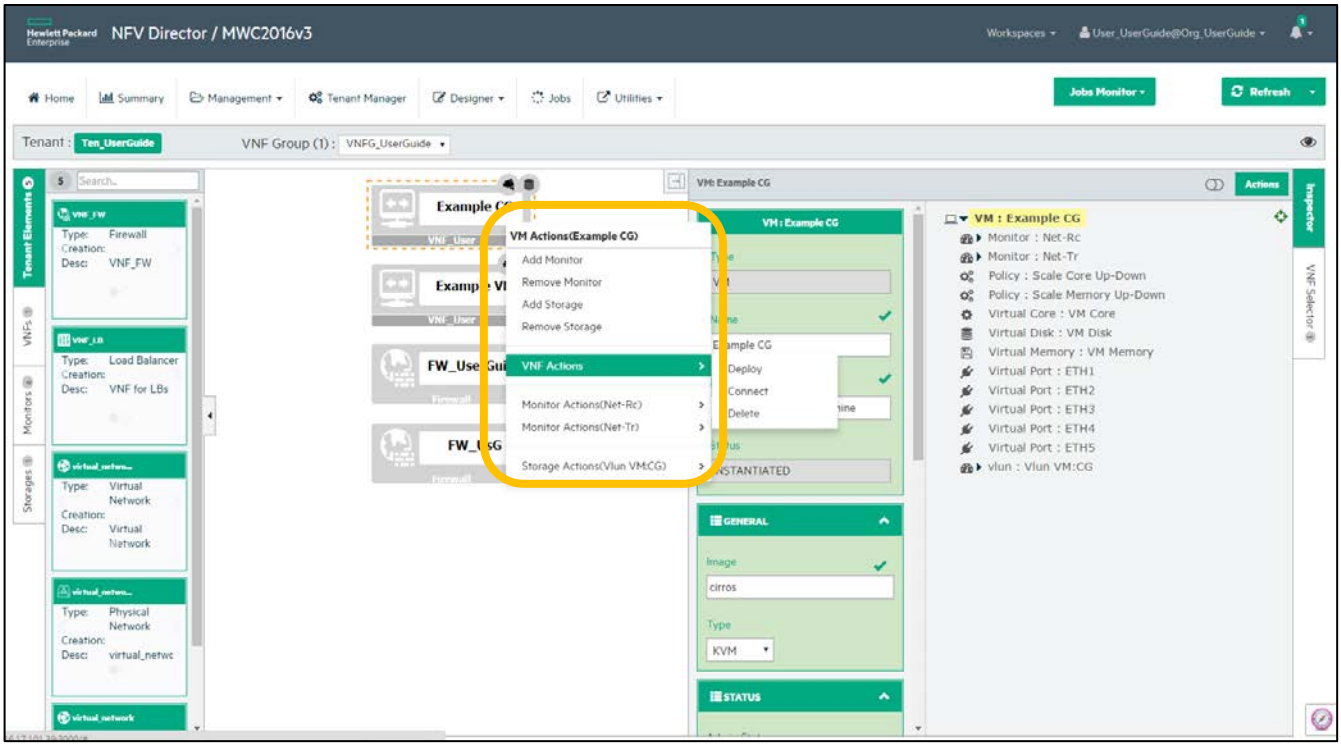


Figure 209: Available user-created VNF actions

There are two ways to access the list of available actions.

- Left-click **Actions**.
- Right-click the previously selected element in the workspace.

The **VDC Manager** will display a list of available actions. The available actions are the same as those explained earlier in this chapter, including actions for the specific element, such as monitor or VLun actions.

2.1.4.1.1 Non-active VNF operations

This section includes all the available non-active VNF operations in the **VDC Manager**.

2.1.4.1.1.1 Creating a VNF

There are two ways to create (instantiate) a VNF.

- Select the element from the list and drag it to the workspace.
- Select the element from the list, left-click **Actions**, and select **Create**.

When a VNF is selected from the list of components, the component's border color will turn green. The system will also generate the timestamp for the component. These changes are indicated in the following illustration.

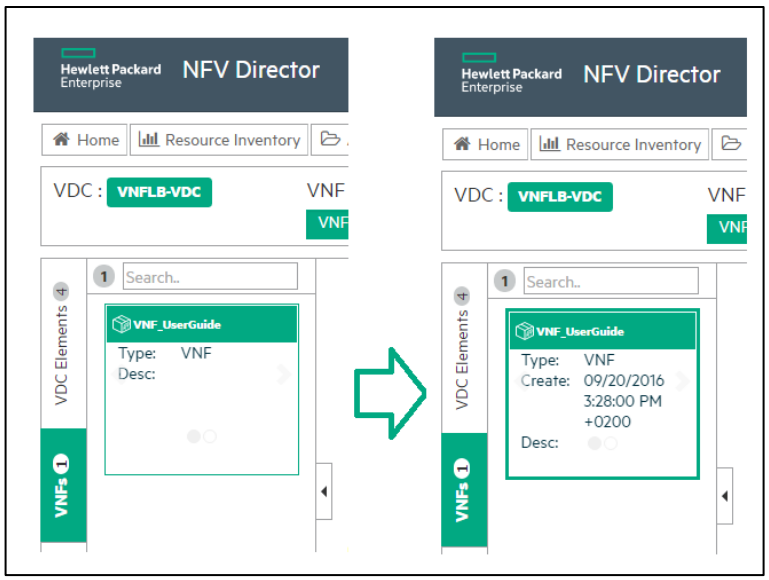


Figure 210: Creating a VNF

Regardless of the method used to create the instance, the same window will be displayed.

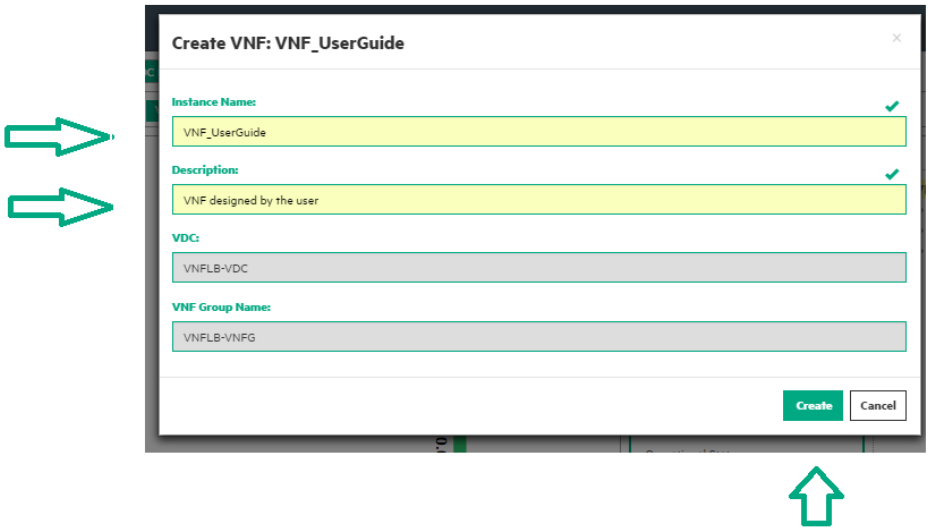


Figure 211: Create VNF window

For this VNF we set the name for the firewall to **VNF_UserGuide** and the Description to **VNF desgined by the user**. The **VDC** and **VNF Group Name** fields are disabled. Left-click **Create** to create the VNF or left-click **Cancel** to discard the changes. Once the element is created, a new VNF will be displayed in the manager's work space. The VNF's grey color indicates that the element is not active.

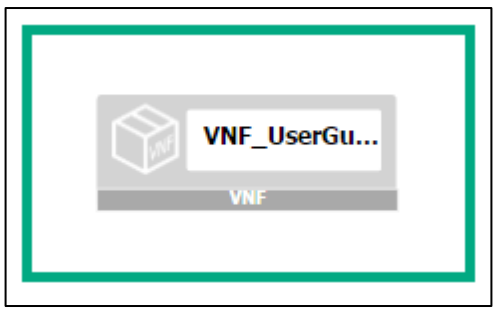


Figure 212: Inactive element

If the deployment process started correctly, the system will display a confirmation message similar to the following illustration. Click the button to access these messages.

Figure 213: Successfully created VNF confirmation message

2.1.4.1.1.2 Deploying a VNF

Select the VNF created in the previous section. Left-click the element until its border has changed to a dashed pattern of a color different from grey. Once selected, there are two ways to initiate deployment:

- Left-click **Actions** and select **Deploy**.
- Right-click in the previously selected element and select **Deploy** from the list that is displayed.

A successful VNF deployment requires connection to a previously activated Virtual Network. Select the VNF in the workspace and right-click in the element to display a list of available actions.

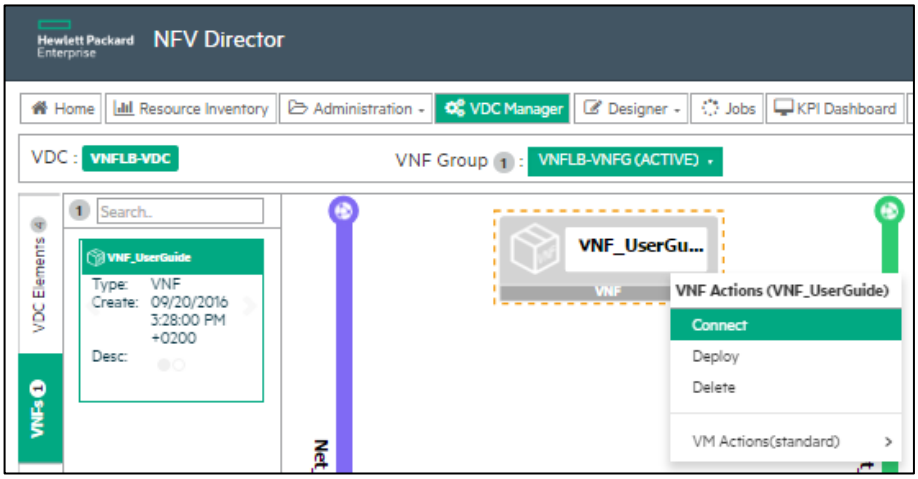


Figure 214: Connecting a VNF to Virtual Networks

Left-click **Connect**, or left-click **Actions**, and select **Connect** to display a window similar to the one in the following illustration.

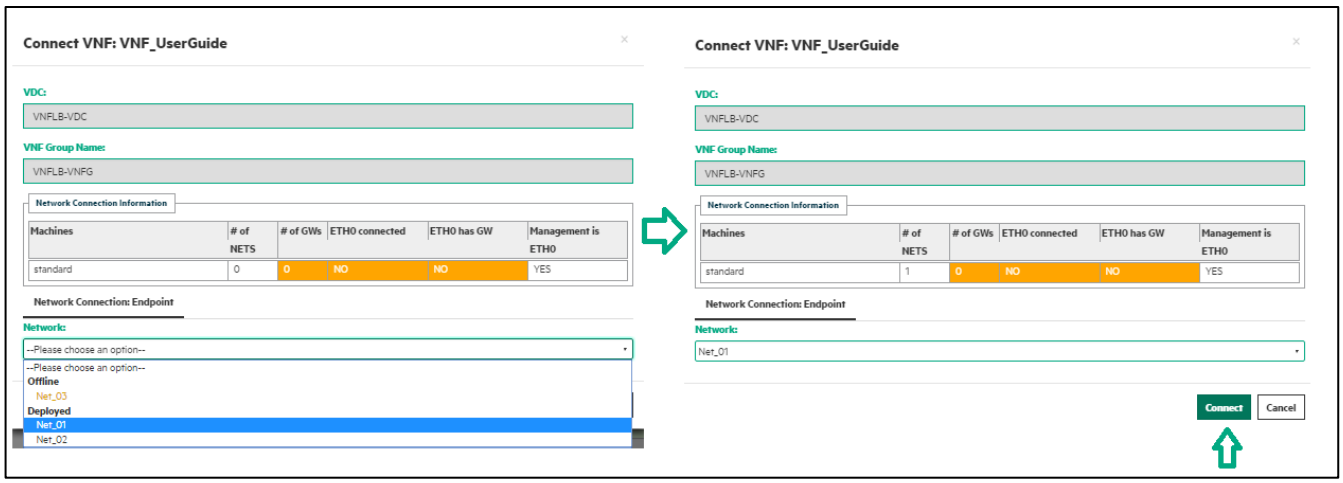


Figure 215: Configuration form for connecting VNF endpoints

Due to the nature of the VNF, at least one endpoint must be selected. The VNF could have more than one, depending on the number of VNF Components and Virtual machines of each component. These endpoints are directly related to the Virtual Networks present in the workspace, so the **Network** field will list all the available networks.

NOTE: An operational VNF connection requires that one network take the role of **Network Connection Endpoint**.

The following illustration indicates the VDC status just prior to starting the deployment.

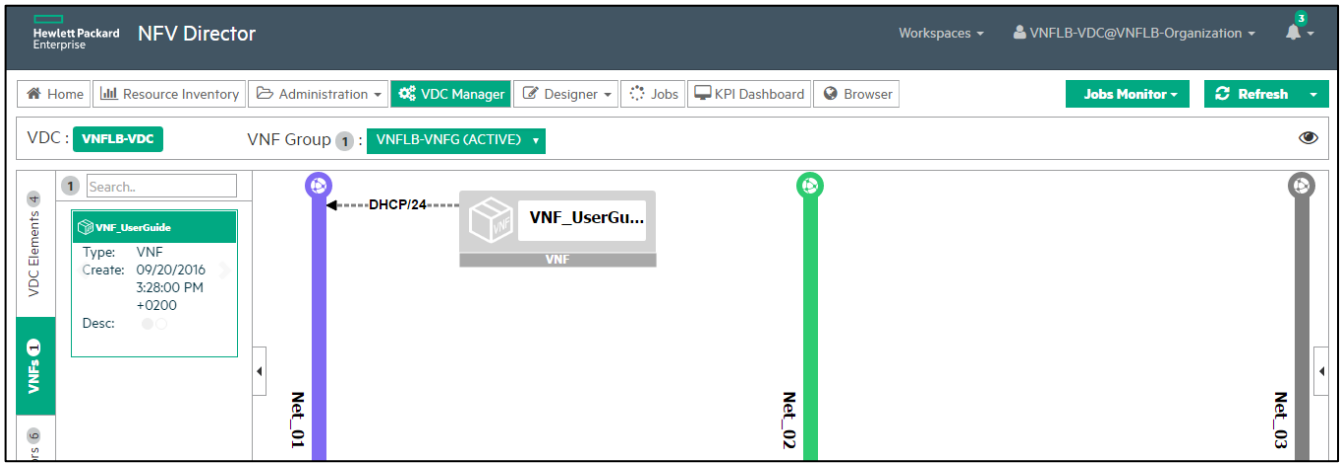


Figure 216: VDC elements

Once the VNF is connected to both activated Virtual Networks, Net_01 and Net_02, a line will be displayed between them and the VNF indicating the connection. The line should be dashed, indicating an inactive connection. If the workspace is similar to the following illustration, then the VNF is ready to be deployed.

There are two ways to start the deployment process.

- Right-click the component in the workspace.
- Left-click **Actions** and select **Deploy**.

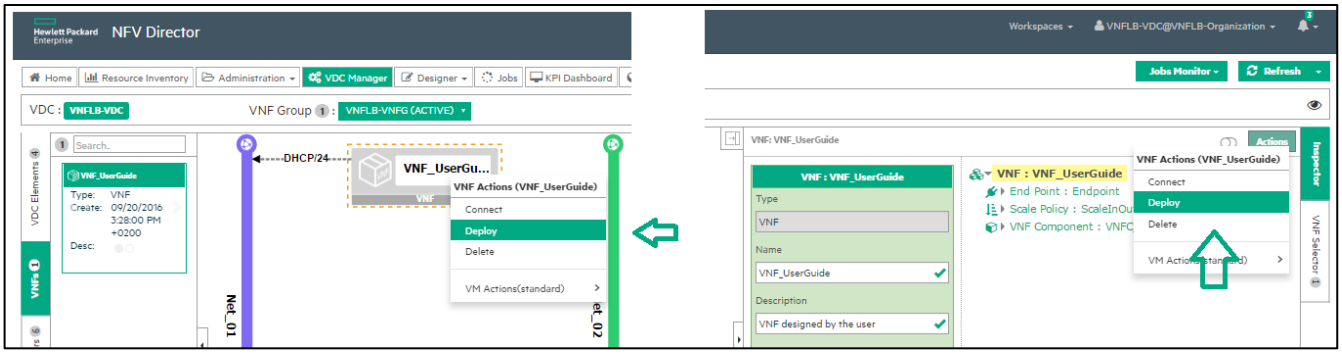


Figure 217: Two ways to launch a Deploy a VNF

After selecting **Deploy**, the following window will be displayed.

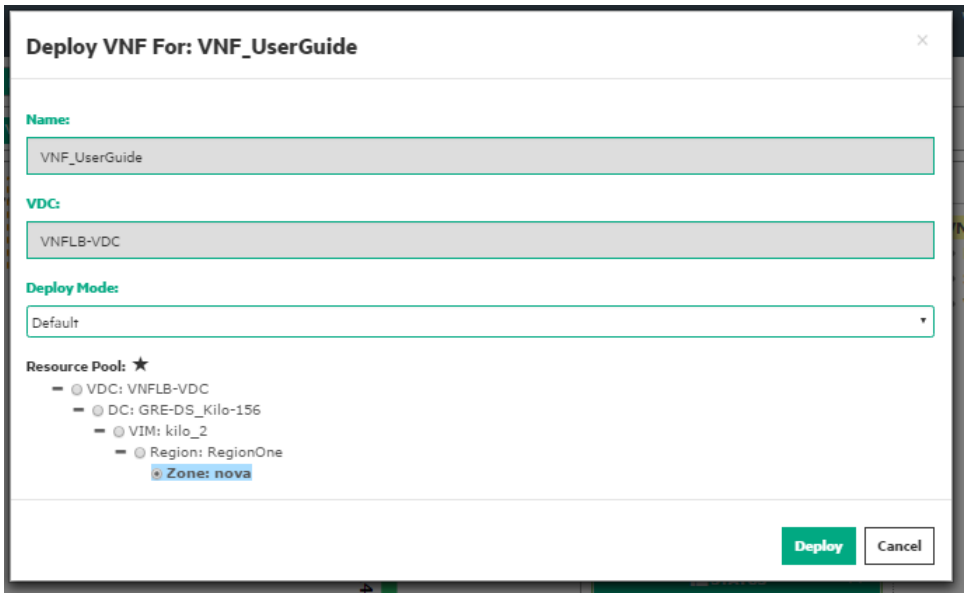


Figure 218: VNF Deployment configuration

The only deployment mode available for the VNF is **Default**, which executes the actions for each step of the deployment operation without ensuring or simulating the result. The results depend on the VNF configuration and scenario.

After selecting the mode, select the VNF deployment destination. There is no level restriction for VNF deployment in the Datacenter. It is enough to select one of the elements in the resource pool list. **Region: regionone→ Zone:nova** is selected for this particular VNF.

Left-click **Deploy** to deploy the element. If the deployment process started correctly, the system will display a confirmation message and register in the **Jobs Monitor** similar to the following illustrations.

Click the  button to access these messages.

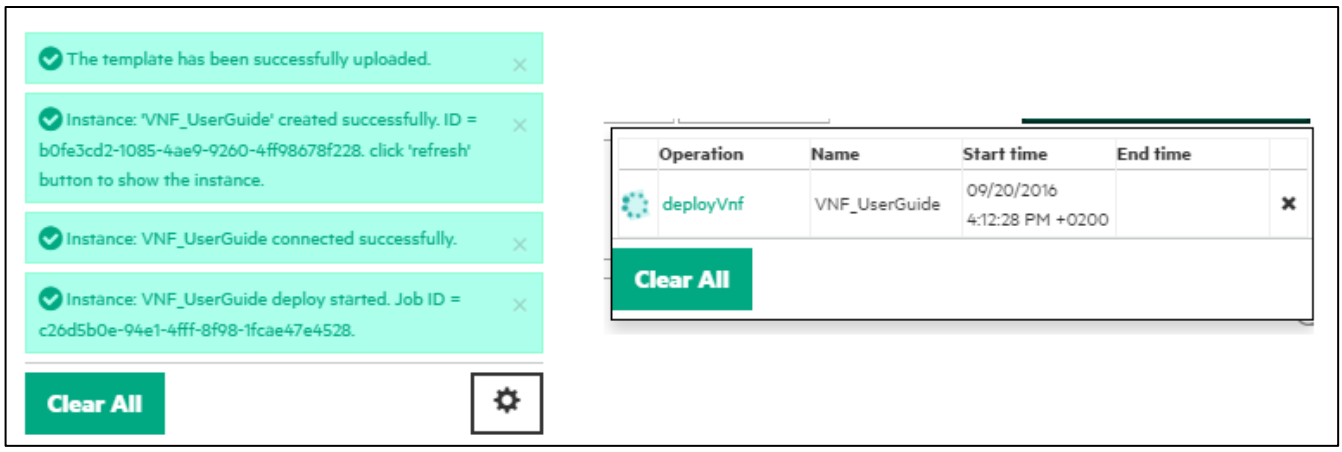


Figure 219: VNF deployment confirmation message and job registration

If the deployment process ended properly, the color of the element will change to green, indicating **ACTIVE** status. If the color of the element changes to red, it indicates **ERROR** status. If the deployment process was not able to activate the element, the components in the workspace at the end of the process should be in the same state as prior to deployment. The element displayed after successful deployment is similar to the following illustration.

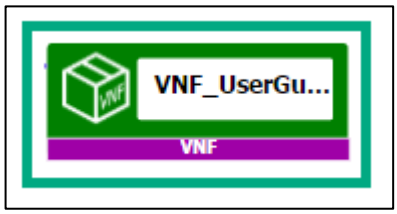


Figure 220: Successful deployment

During the deployment of the VNF, its components will retain the **INSTANTIATED** status. This is because the VNF component is a member of the Virtual Machines group, and the rest of the elements that are part of the VNF, including policies, monitors, or Virtual Luns, are treated as the container in this version. A component status change is not required to perform any operation.

NOTE:

If there is a VDC with Management, the VNF will connect to the Management Network during deployment.

Select **Apply Changes** for the VNF instance after successful deployment to deploy a VNF with one or more monitors.

2.1.4.1.1.3 Deleting a VNF

Select the **VNF** in the workspace and left-click inside and element to change its border to a dashed line that is any color but grey. There are two ways to initiate deleting.

- Left-click **Actions** and select **Delete**.
- Right-click inside the previously selected element and select **Delete** from the displayed list.

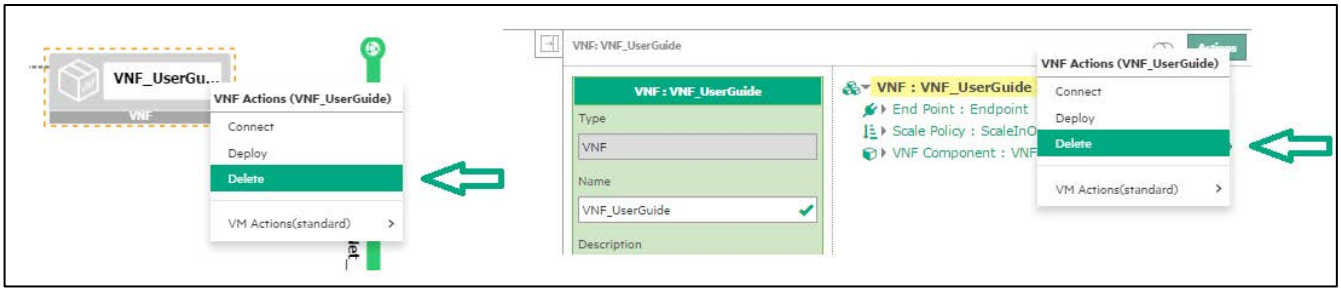


Figure 221: Delete VNF action

After the required action has been selected, the **VDC Manager** will display the following window:

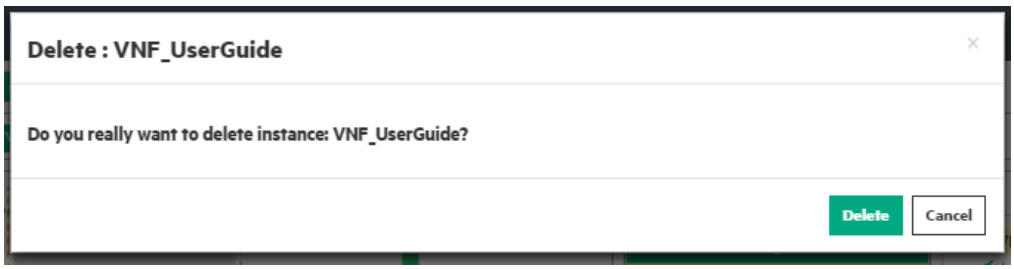


Figure 222: Delete VNF confirmation window

Left-click **Delete** to delete the element. If the deleting process started correctly, the system will display a confirmation message.

Click the  button to access these messages.

2.1.4.1.2 Activated VNF operations

This section lists the actions available for an activated generic VNF. The following operations are available from the **VDC Manager**:

- creating
- deploying
- deleting

After the component has been activated, the **VDC Manger** allows the following additional operations:

- scaling
- un-deploying

Activating the VNF enables additional operations:

- Scale Up
- Scale Down
- Scale In
- Scale Out
- Un-Deploy
- Apply changes
- Connect
- Heal
- Deploy All KPIs

The **Scale** operations can only have one element as target. Each element requires a policy, meaning the VNF Components and the VNF each require a Scale policy in order to escalate. If a policy needs to elevate more than one element, it will only scale one, leaving the others unaltered.

2.1.4.1.2.1 Updating a VNF field

After making changes to any of the attributes of the elements in the **VDC Manager** workspace or attributes displayed in the **Inspector**, such changes must be saved. There are two ways to save changes:

- Left-click **Actions** and select **Update**.
- Right-click any blank space in the **VDC Manager** and select **Update**.

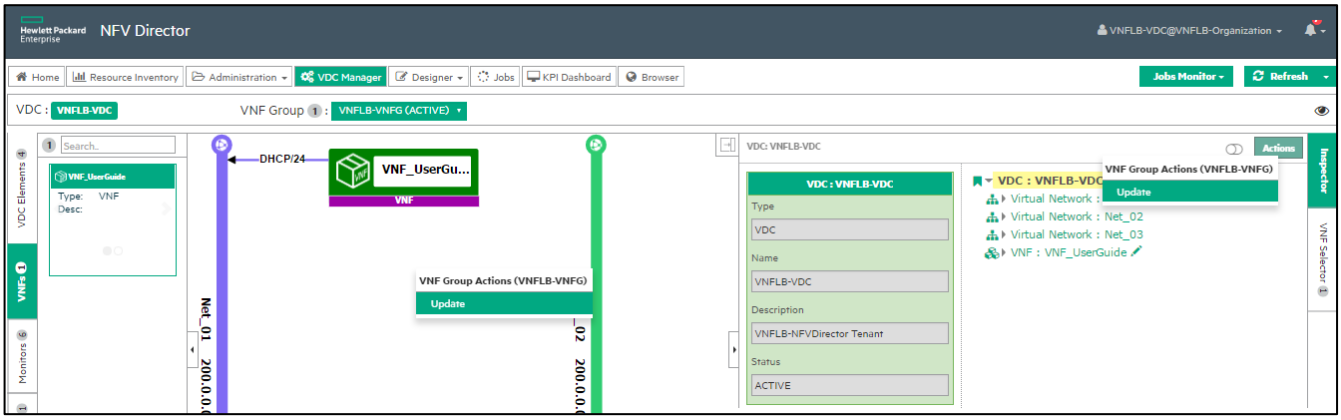


Figure 223: Update action in the VDC Manager

Selecting **Update** displays a new form indicating all the fields that have been modified. Left-click **Update** to apply the changes and modify the image used to activate the VM.

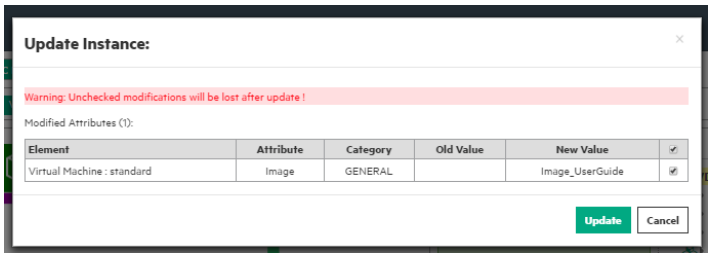


Figure 224: Update fields confirmation window

The following illustration indicates the message in the notification area after the update has been applied.

Figure 225: Update successful message in the notification area

2.1.4.1.2.2 Applying VNF changes

Changes to any of the components in the **VDC Manager** workspace, for example adding a new monitor or Lun to some entity, must be saved. There are two ways to save these changes.

- Left-click **Actions** and select **Apply Changes**.
- Right-click any blank space in the **VDC Manager** and select **Apply Changes**.

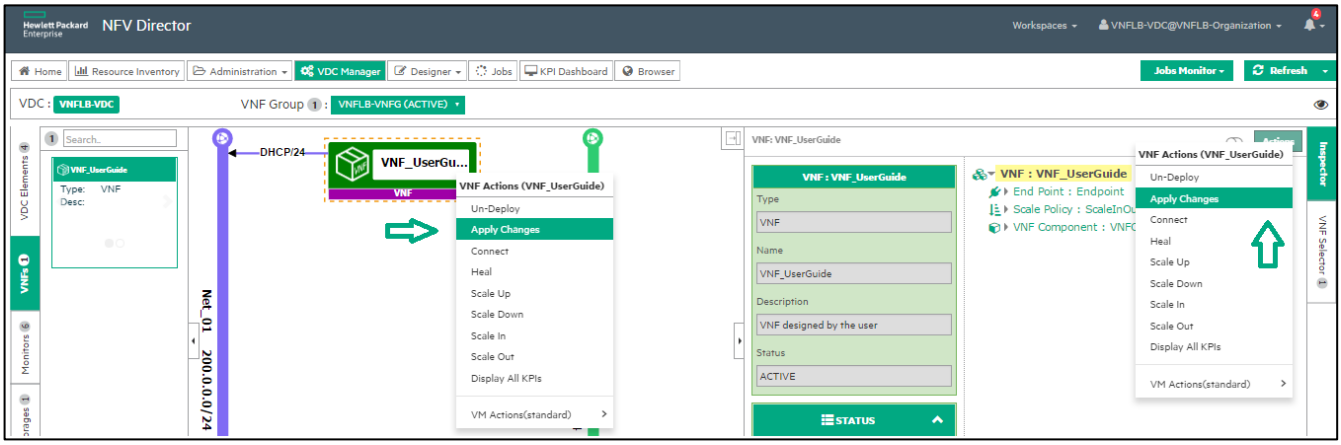


Figure 226: Apply Changes action in the VDC Manager

Selecting **Apply Changes** will display a new form. Select **Default** in the **Apply Changes Mode** field and left-click **OK** to execute the action.

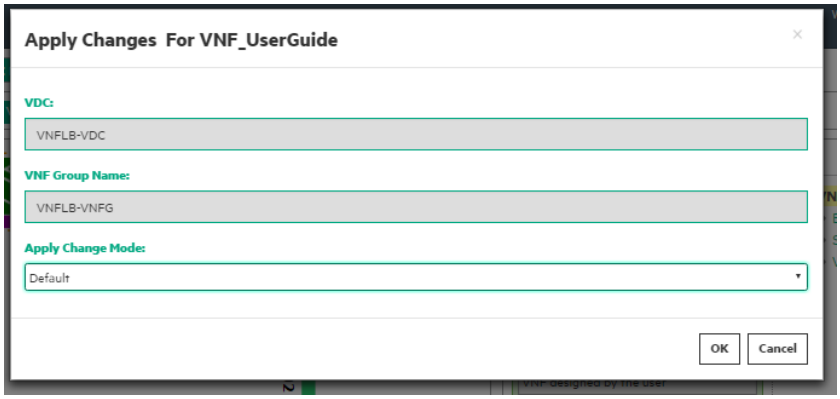


Figure 227: Apply Changes to the VNF

Clicking **OK** will display a new confirmation message in the notification area and a new message in the **Jobs Monitor**.

2.1.4.1.2.3 Un-deploying a VNF

The **Un-deploy** operation is only available if the specific **VNF** has **ACTIVE** status. There are two ways to initiate un-deployment.

- Right-click the element and select **Un-Deploy** from the displayed list.
- Select the element in the workspace, left-click **Actions** and select **Un-Deploy**.

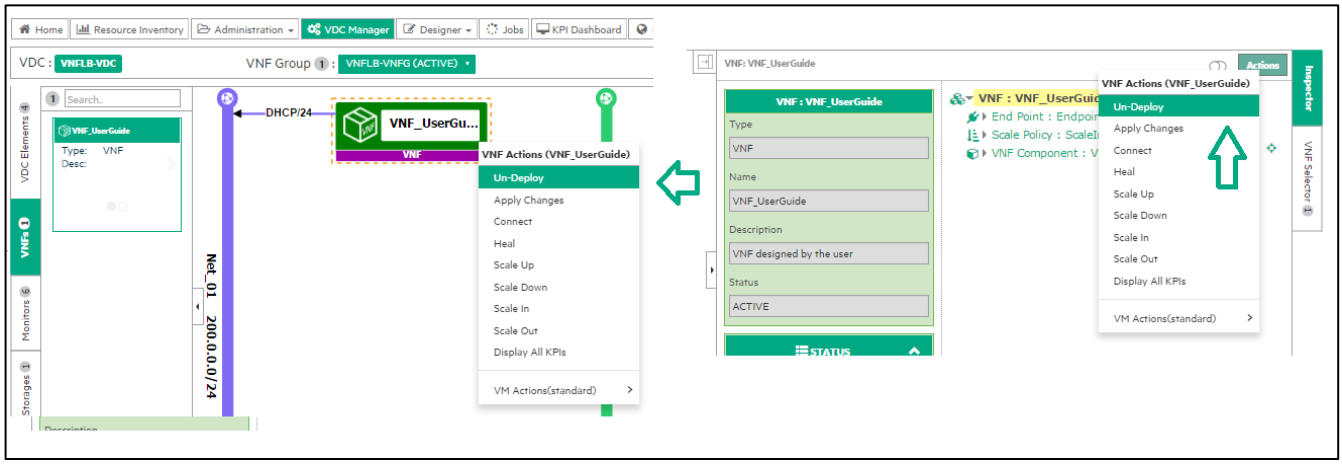


Figure 228: Un-deploy VNF action

After the **Un-deploy** operation has been selected, the following confirmation window will be displayed.

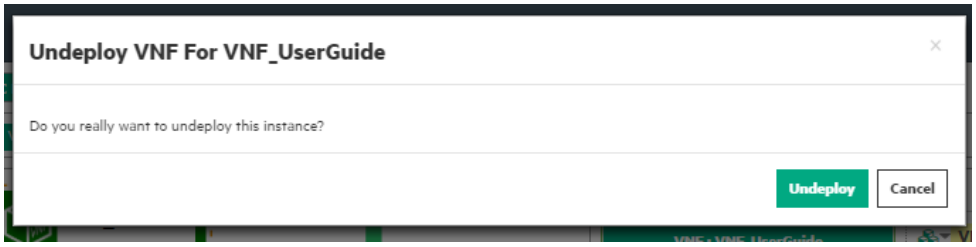


Figure 229: Un-deploy operation confirmation window

Left-click **Un-deploy** to un-deploy the selected VNF or left-click **Cancel** to discard the un-deployment process. If the un-deployment process is executed correctly, the element will be removed from the workspace.

2.1.4.1.2.4 Scale Up a VNF

If execution requires a **Scale Up** operation, it can be selected from the list of operations. There are two ways to launch a **Scale Up** operation from the component.

- Right-click in the VNF in the workspace and select **Scale Up**.
- Left-click **Actions** and select **Scale Up** from the displayed list.

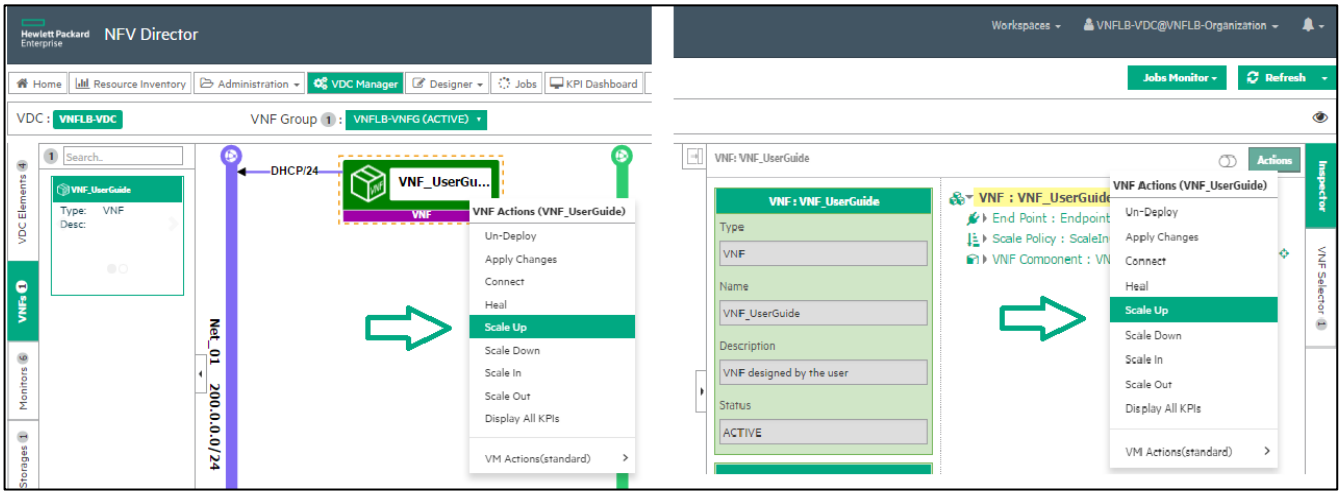


Figure 230: Two ways to Scale Up a VNF

After the operation has been selected, the following confirmation window will be displayed.

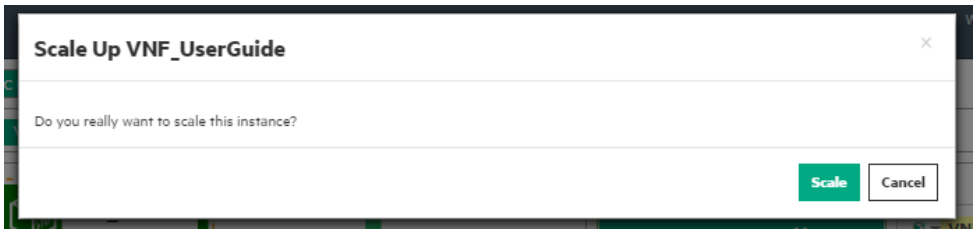


Figure 231: Scale Up a VNF confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.1.2.5 Scale Down a VNF

If execution requires a **Scale Down** operation, it can be selected from the list operations. There are two ways to launch a **Scale Down** operation from the component.

- Right-click in the VNF in the workspace and select **Scale Down**.
- Left-click **Actions** and select **Scale Down** from the displayed list.

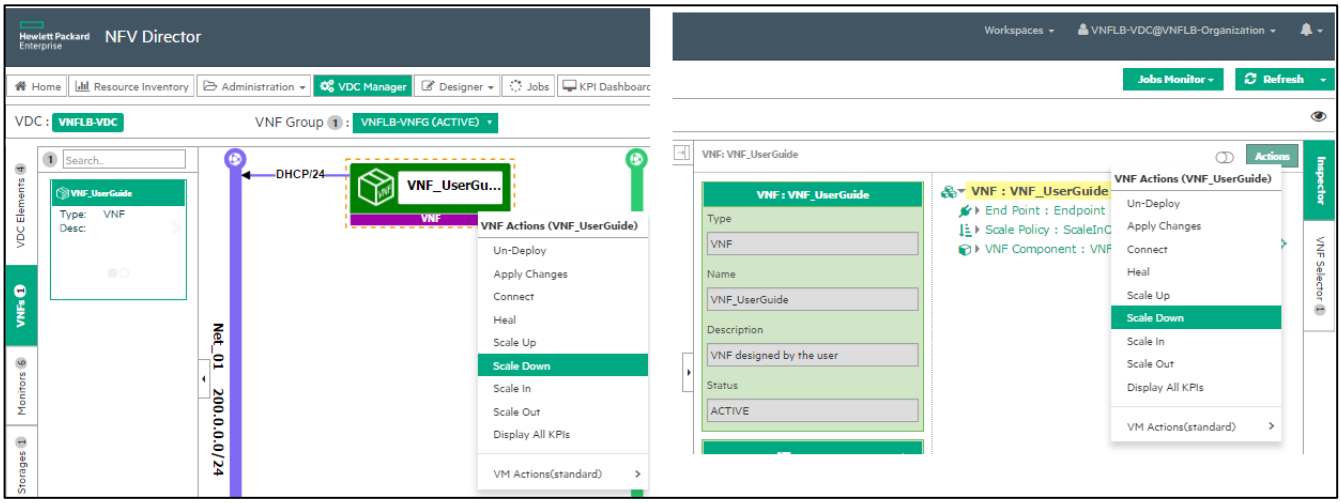


Figure 232: Two ways to Scale Down a VNF

After the operation has been selected, the following confirmation window will be displayed.

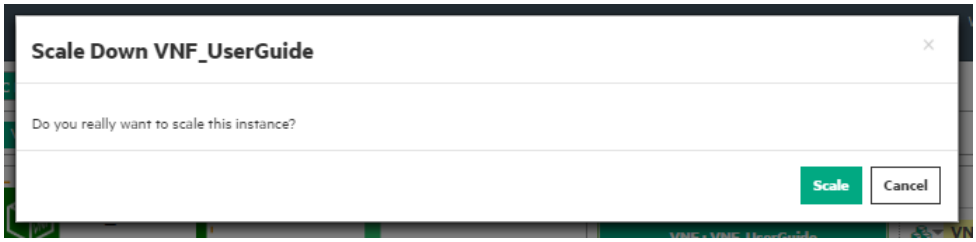


Figure 233: Scale Down a VNF confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.1.2.6 Scale In a VNF

If execution requires a **Scale In** operation, it can be selected from the list of operations. There are two ways to launch a **Scale In** operation from the component.

- Right-click in the VNF in the workspace and select **Scale In**.
- Left-click **Actions** and select **Scale In** from the displayed list.

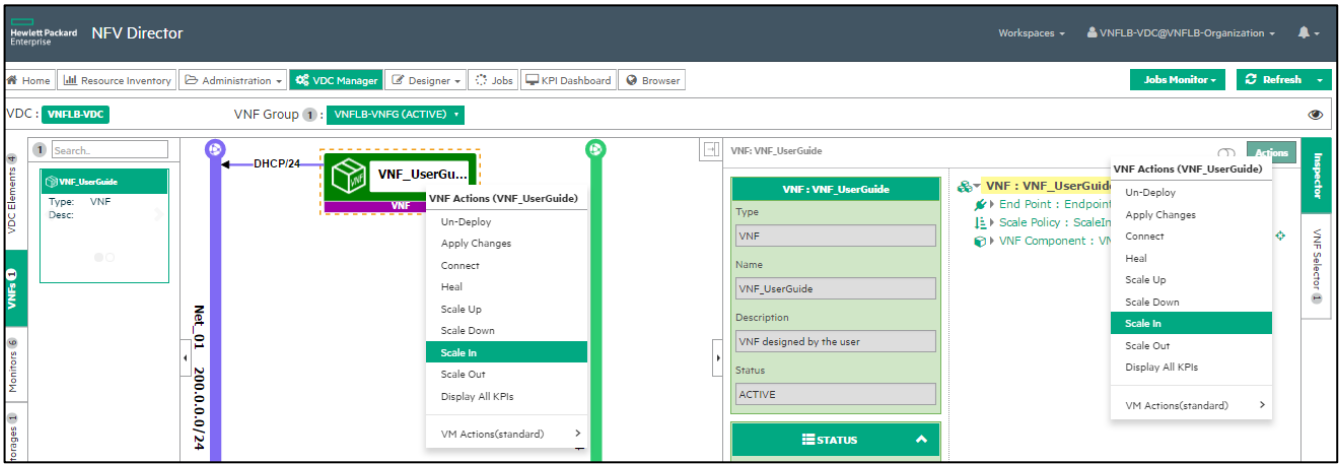


Figure 234: Two ways to Scale In a VNF

After the operation has been selected, the following confirmation window will be displayed.

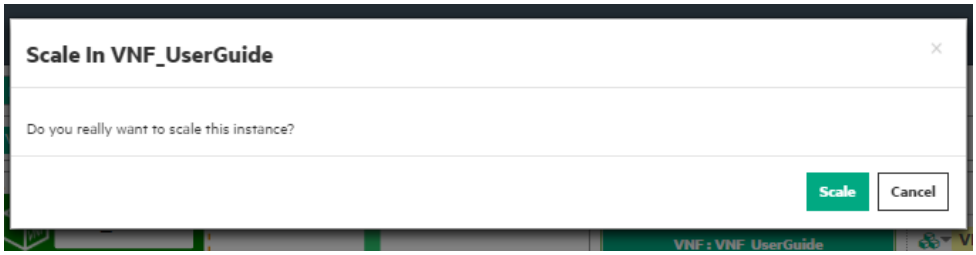


Figure 235: Scale In a VNF confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.1.2.7 Scale Out a VNF

If execution requires a **Scale Out** operation, it can be selected from the list of operations. There are two ways to launch a **Scale Out** operation from the component.

- Right-click in the VNF in the workspace and select **Scale Out**.
- Left-click **Actions** and select **Scale Out** from the displayed list.

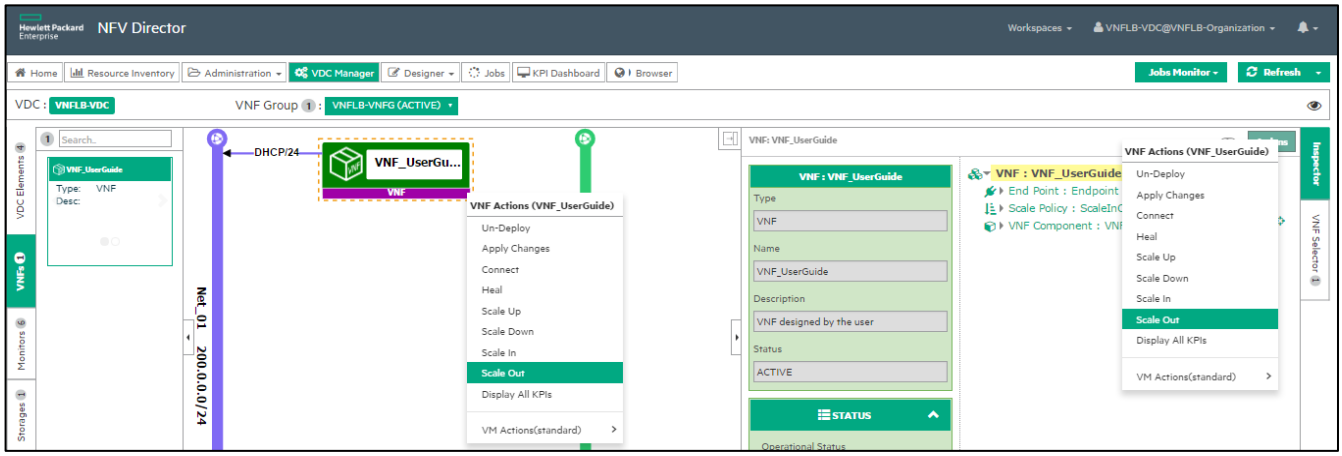


Figure 236: Two ways to Scale Out a VNF

After the operation has been selected, the following confirmation window will be displayed.

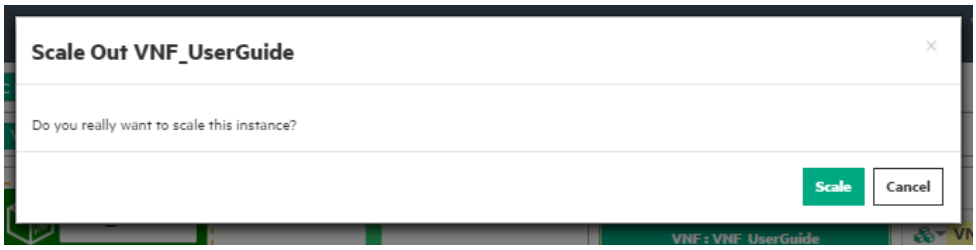


Figure 237: Scale Out a VNF confirmation window

Left-click **Scale** to start the escalation process, or left-click **Cancel** to discard the process. If the escalation is executed correctly, the element will be removed from the workspace.

NOTE: Escalation policies operate along with **Entity Scale Policies**, so when initiating this type of process, check which of the policies developed by the user is going to be executed.

2.1.4.1.2.8 Healing a VNF

A **Heal Policy** indicates a **Heal** cause and the workflow that will be executed in the NVFD when the user triggers the **Heal** operation for a VNF or a VNF component. This type of policy will perform its configured action even if the operation that has triggered the policy is still in execution.

At least one **Heal** policy needs to be configured in the VNF in order to execute be able to execute it. Refer to the *Error! Reference source not found.* and *Error! Reference source not found.* chapters on how to configure these policies. There are two ways to execute the policy.

- Left-click **Actions** and select **Heal**.
- Right-click the VNF and select **Heal**.

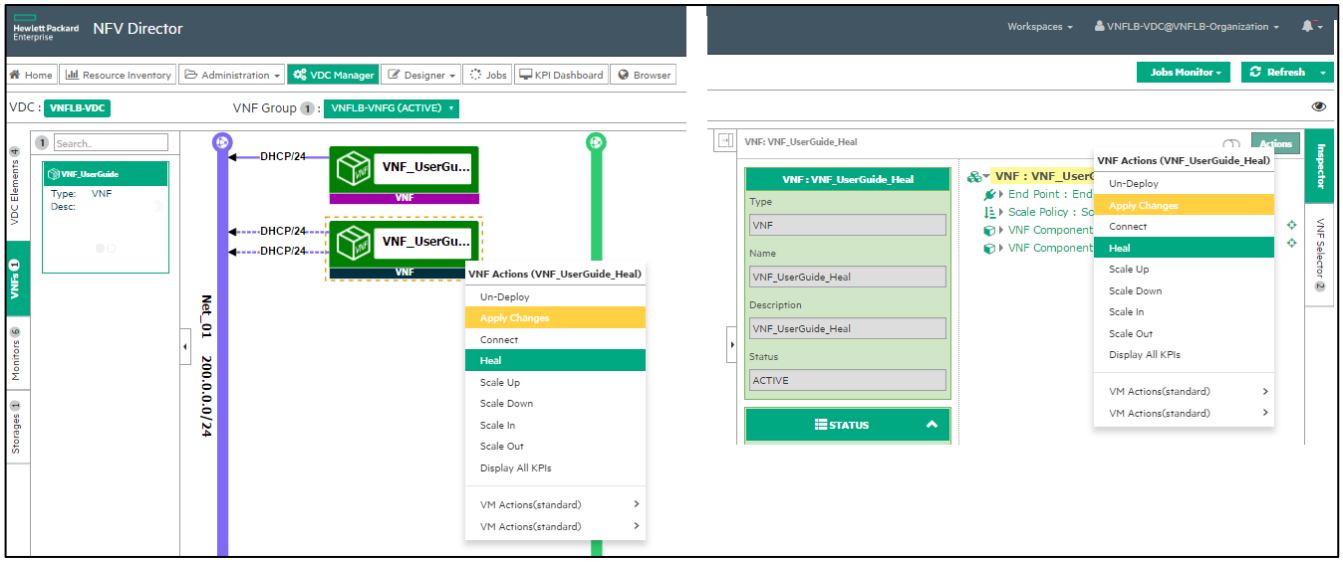


Figure 238: Two ways to execute a Heal policy

Selecting the **Heal** action will display a new window indicating the causes of the **Heal** configured during the creation of the policy. Set the **Heal** causes when designing the VNF Components and the VNF (*Error! Reference source not found.* and *Error! Reference source not found.* chapters). There are two causes set up in the illustration, **Cause A** and **Cause B**. Select either one and left-click **Heal** to launch the policy for the VNF.

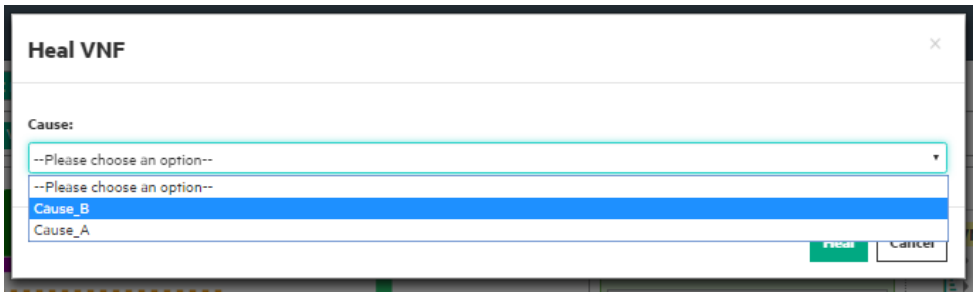


Figure 239: Select Heal cause

A new message will be displayed in the notification are, indicating the result of the **Heal** policy.

2.1.4.1.2.9 Displaying all KPIs of the VNF instance

This operation browses all the KPIs collected by all the monitors in the VNF/VMs. The latest KPI values are listed in the dialog box and clicking **Refresh** will update them.

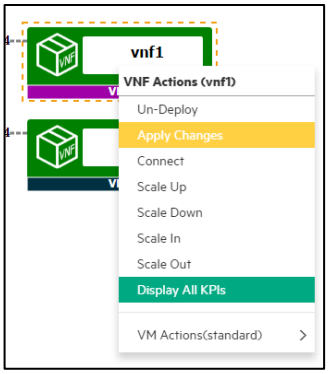


Figure 240: Displaying all KPIs of the VNF instance

2.1.5 Virtual Machine operations

Operating with Virtual Machines in the **VDC Manager** requires a VNF with an activated VM. This is usually a VNF created by the user in the **VNF Designer**. The following section describes the operations available in the **VDC Manager** with an activated VM.

NOTE:

The Virtual Machine will be activated when the VNF that hosts these elements go through an activation process.

The Virtual Machines and the VNF operations menu are available through the **VDC Manager**.

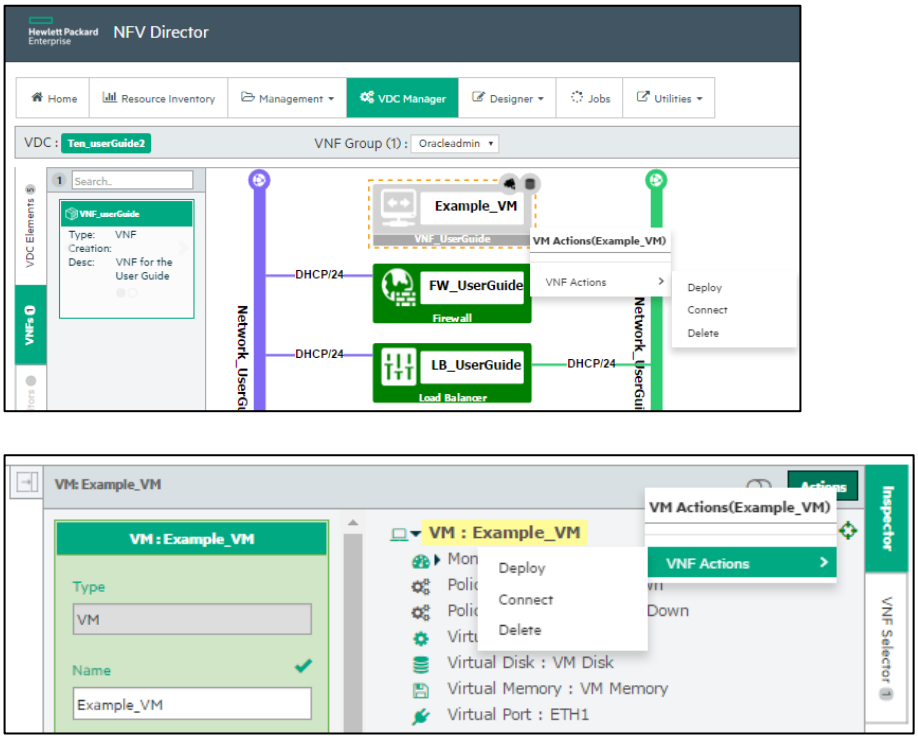


Figure 241: Two ways to access VNF Actions in a user-created VNF

2.1.5.1 Stopping a Virtual Machine

There are two ways to stop the Virtual Machine.

- Right-click in the VNF that hosts the VM and select **Stop**.
- Left-click **Actions** and select **Stop**.

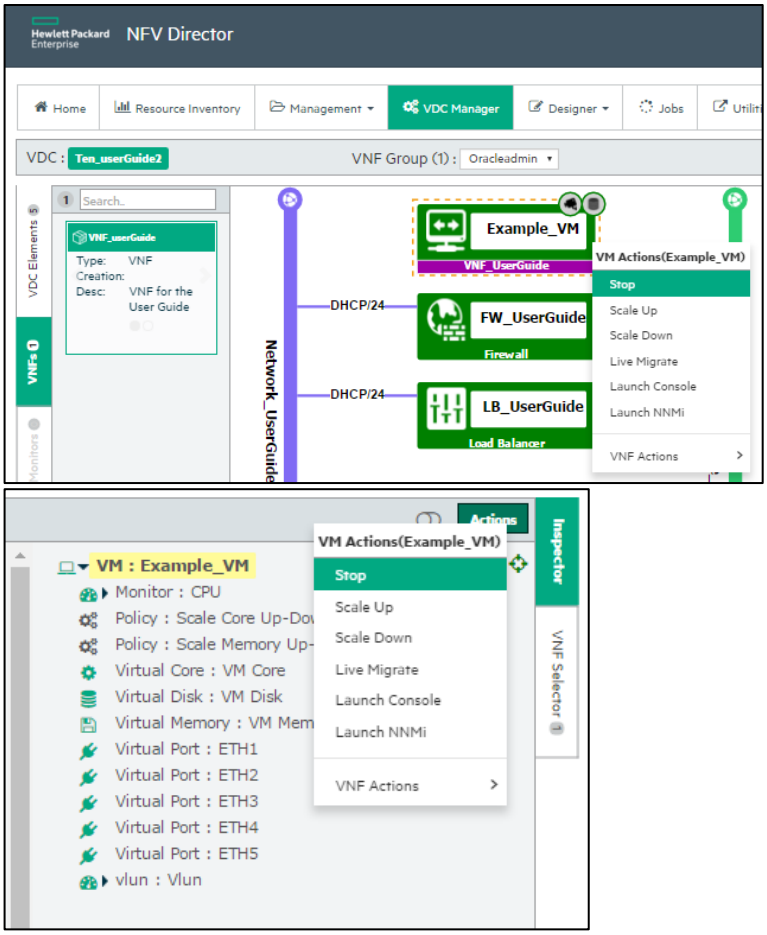


Figure 242: Two ways to stop a Virtual Machine

After the operation has been selected, the following confirmation window will be displayed.

Figure 243: Stop a Virtual Machine confirmation window

Left-click **Stop** to stop the Virtual Machine. If the Virtual Machine was stopped correctly, the system will display a confirmation message and register the job in the **Jobs Monitor**.

Click the  button to access these messages.

2.1.5.2 Launching the Virtual Machine Console

here are two ways to launch the Virtual Machine Console.

- Right-click in the VNF's Virtual Machine and select **Launch Console**.
- Left-click **Actions** and select **Launch Console**.

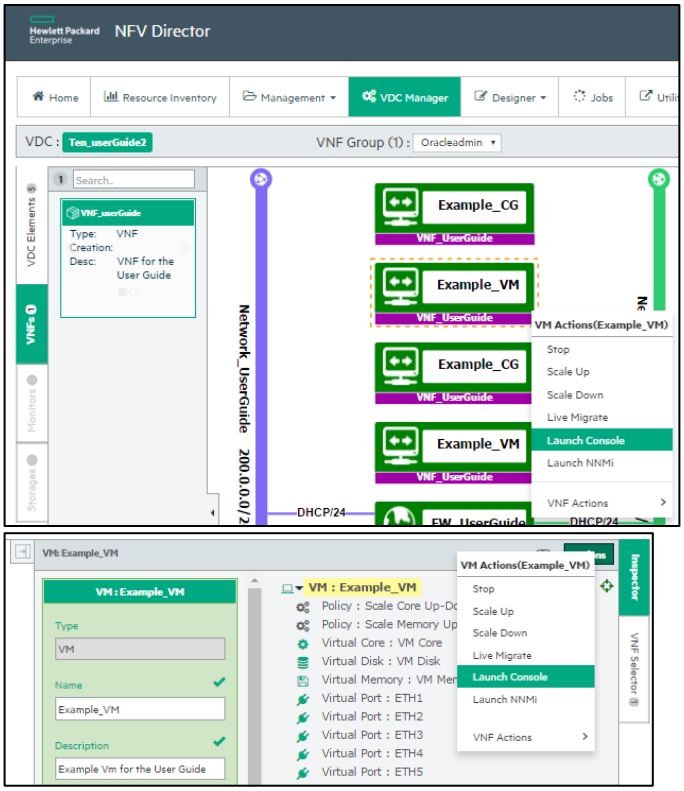


Figure 244: Two ways to launch the Virtual Machine Console

After the required action has been selected, the **VDC Manager** will display the following window:

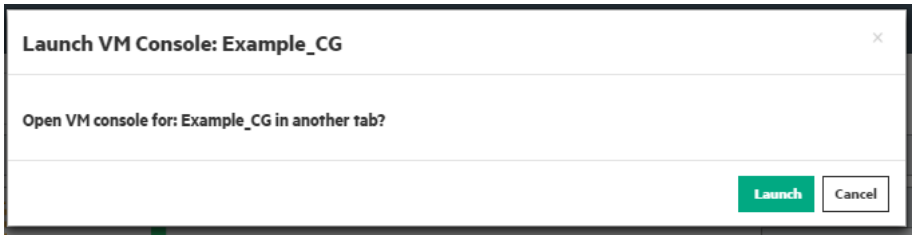


Figure 245: Launch Virtual Machine Console confirmation window

Left-click **Launch** to launch the element's console. If the console started correctly, the system will display a confirmation message and the console will load in a new web page similar to the following illustration.

Click the  button to access these messages.

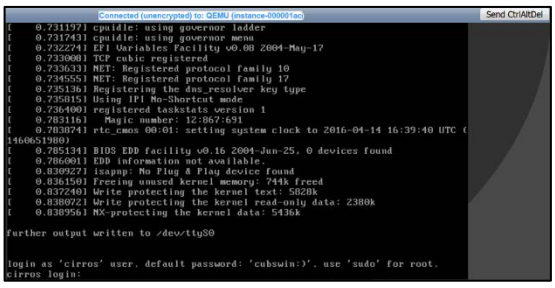


Figure 246: Virtual Machine Console

2.1.5.3 Launching NNMi of a Virtual Machine

There are two ways to launch a Virtual Machine Console.

- Right-click in the VNF's Virtual Machine and select **Launch Console**.
- Left-click **Actions** and select **Launch Console**.

After selecting the **Launch Console** action, the **VDC Manager** will open the login page of the **HPE Network Node Manager i** web page. Enter the required credentials to access **Node Manager**.

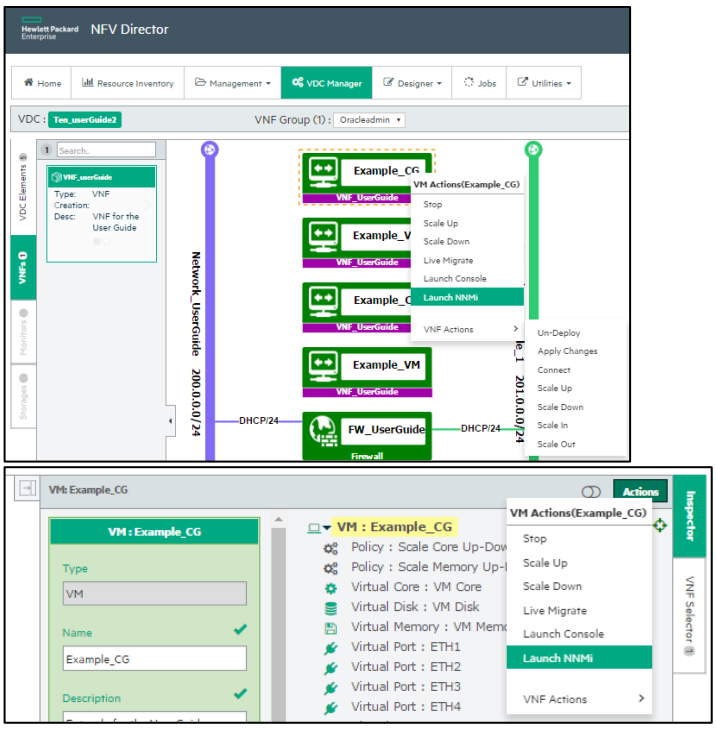


Figure 247: Two ways to launch NNMi from a Virtual Machine

2.1.5.4 Connecting the VNF

If changes are required to an attribute or configuration of the networks associated with the VNF, the VNF needs to connect to the network. There are two ways to connect.

- Left-click the element's **VNF Actions** and select **Connect**.
- Left-click **Actions** and select **VNF Actions→Connect**.

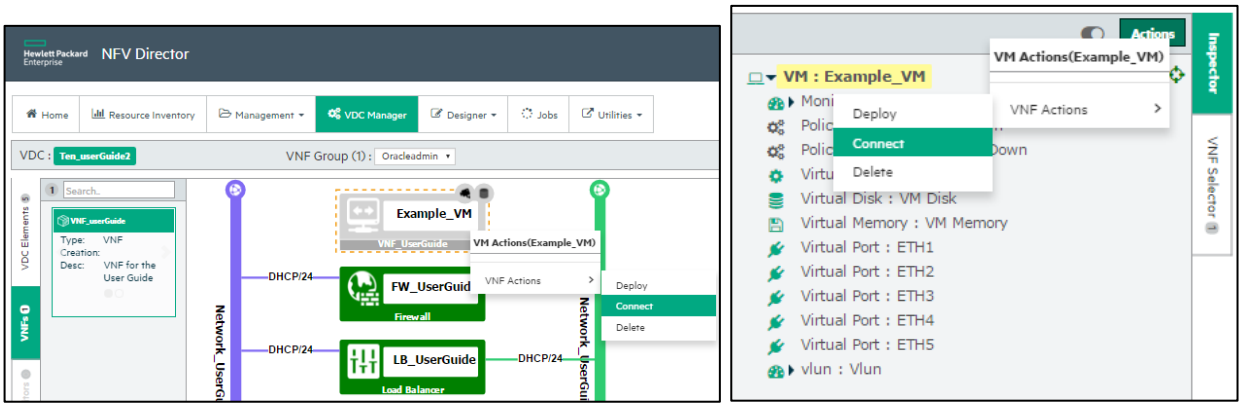


Figure 248: Two ways to connect a Virtual Machine

After the required action has been selected, the following window will be displayed to edit certain element attributes.

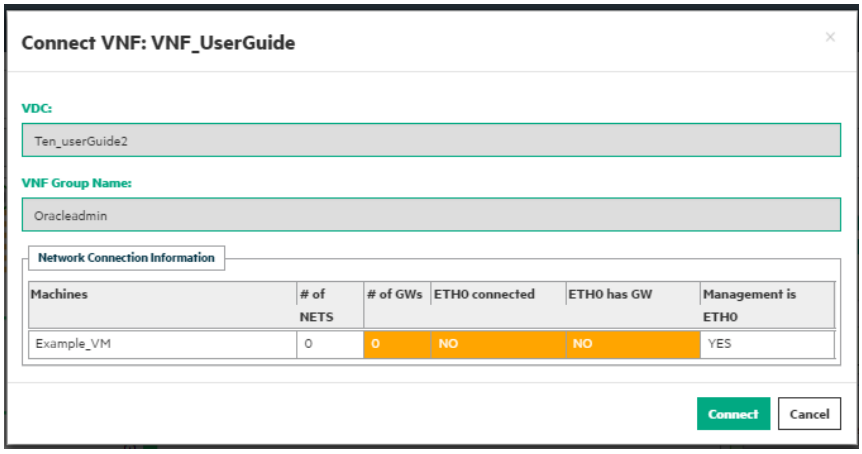


Figure 249: Virtual Machine connection configuration window

Left-click **Connect** to connect the Virtual Machine to the listed networks. If the connection was successful, the system will display a confirmation message in the notification area.

Click the button to access these messages.

Figure 250: Virtual Machine successful connection confirmation message

2.1.5.5 Attaching a Floating IP to a Virtual Machine

A **Floating IP** is a publicly-accessible static IP address that can be assigned to one entity.

NOTE: The entity owner of the Floating IP still keeps its original public IP address, which will remain unchanged. Instead, a Floating IP will provide an additional static IP address that can be used to access the entity.

When using Floating IPs, the user should identify two parts beside the Floating IP itself.

- Active server: This receives user traffic forwarded from the Floating IP.
- Passive server: This is a standby server usually configured identical to the active server. It will receive traffic only during a failover event.

The Floating IP address points to one of the servers. A Floating IP can also be reused in another port of another VM, but can only be used by one port at a time.

If execution requires assigning a Floating IP address to the Virtual Machine, there are two ways to do this.

- Right-click the Virtual Machine in the workspace and select **Attach Floating IP**.
- Left-click **Actions** and select **Attach Floating IP**.

After the required action has been selected, the **VDC Manager** will display a confirmation window. Left-click **Attach** to start assigning the Floating IP address. If the process started correctly, the system will display a confirmation message.

Click the button to access these messages.

2.1.5.6 Deleting a Floating IP from a Virtual Machine

Select the Virtual Machine with the Floating IP in the workspace. To select an element, left-click inside it in the workspace until its border has changed to a dashed line that is any color but gray. Once selected, there are two ways to initiate deleting:

- Left-click **Actions** and select **Delete Floating IP**.
- Right-click in the previously selected element and select **Delete Floating IP** from the list that is displayed.

After the required action has been selected, the **VDC Manager** will display the following window.

Figure 251: Delete Floating IP confirmation window

Left-click **Delete** to delete the Floating IP. If the deleting process started correctly, the system will display a confirmation message.

Click the  button to access these messages.

2.1.5.7 Deleting a Virtual Machine

Select a Virtual Machine in the workspace with **INSTANTIATED** status. To select an element, left-click inside it in the workspace until its border has changed to a dashed line that is any color but gray. Once selected, there are two ways to initiate deleting:

- Left-click **Actions** and select **Delete**.
- Right-click in the previously selected element and select **Delete** form the list that is displayed.

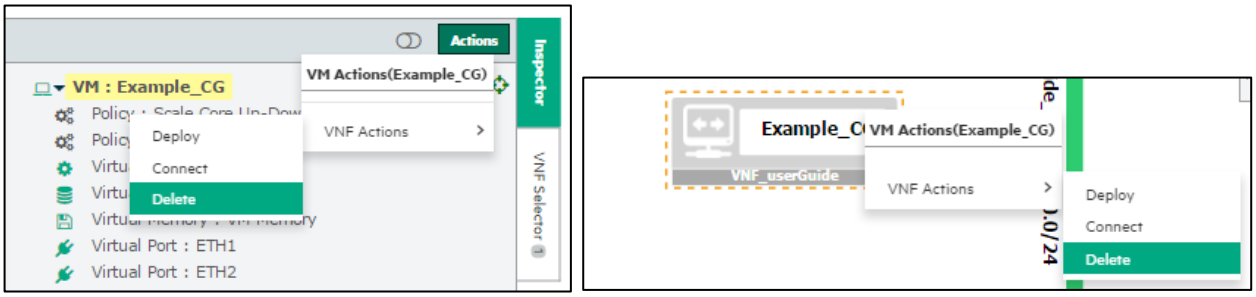


Figure 252: Two ways to delete a Virtual Machine

Deleting a Virtual Machine will delete the VNF that hosts the specific Virtual Machine. After the required action has been selected, the **VDC Manager** will display the following window.

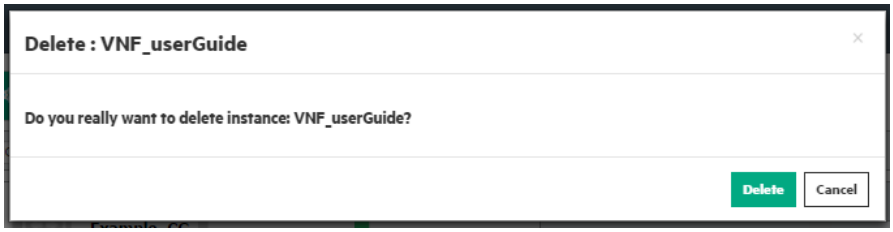


Figure 253: Deleting a Virtual Machine confirmation window

Left-click **Delete** to delete the Virtual Machine. If deleting started correctly, the system will display a confirmation message similar to the following illustration.

Click the  button to access these messages.

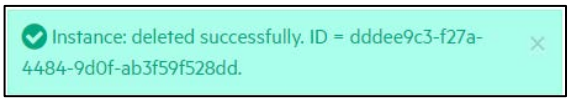


Figure 254: Deleting a Virtual Machine confirmation message

2.1.6 Monitor operations

This section describes how to edit Monitors in the **VNF Designer** if the **Monitor** menu is not disabled.

All **Monitor** operations in the **VDC Manager** are focused on creating and activating Monitors over Virtual Machines, the unique element that Monitors can take as target.

The following Monitor types may be deployed over Virtual Machines:

- **Monitor Disk Write**: Monitors writing operations over the Virtual Disk associated with the Virtual Machine Server.
- **Monitor Disk Read**: Monitors reading operations over the Virtual Disk associated with the Virtual Machine Server.
- **Monitor CPU**: Monitors operations over the Virtual CPU associated with the Virtual Machine Server.
- **Monitor Network Transmitted**: Monitors transmission operations over the Virtual Network related to the Virtual Machine.
- **Monitor Network Received**: Monitors the messages received through the Virtual Network related to the Virtual Machine.
- **Monitor Memory**: Monitors operations over the Virtual Memory associated with the Virtual Machine Server.

There are two ways to create a Monitor.

- Drag the element to the workspace.
- Right-click the previously selected element and select **Create Instance**.

The **VDC Manager** will display the following window.

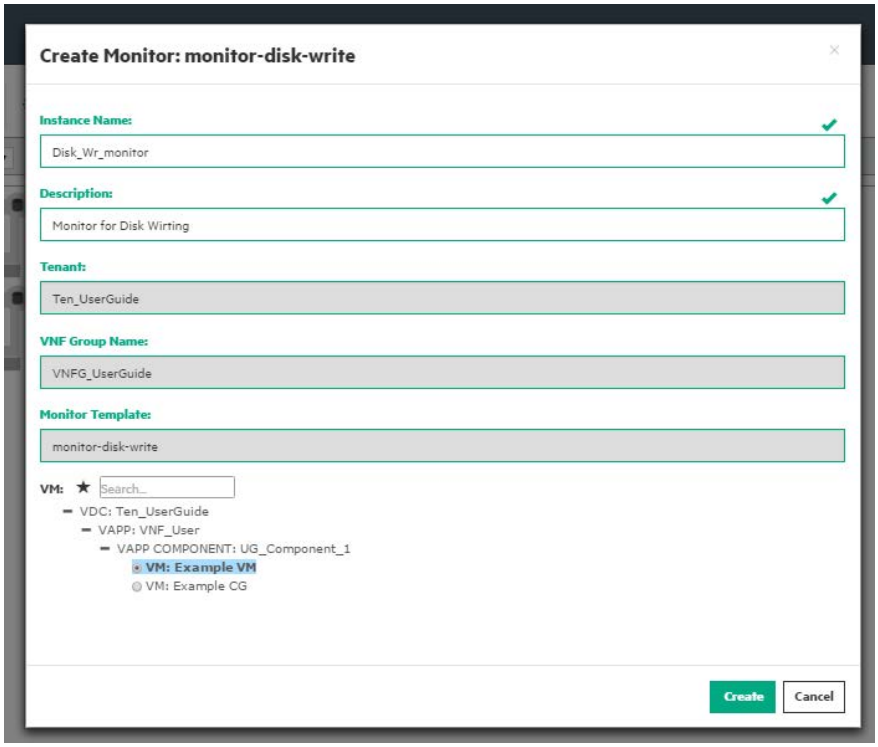


Figure 255: Monitor creation configuration

The **Instance Name** and **Description** fields were completed with the **Disk_Wr_monitor** and **Monitor for Disk Writing** values respectively for this example. Besides these attributes, the attribute referring to the monitor target needs to be completed. In this case the target is one of the user-created Virtual Machines in the VNF, **Example VM**. Left-click **Create** to create the Monitor or left-click **Cancel** to discard the changes.

All **Monitors** are created identically and all have the same editable attributes at this level. A Monitor has an error condition and error action that should be configured before operating with the monitor, else the Monitor will be a dummy. Refer to the *Error! Reference source not found.* chapter (*Error! Reference source not found.* and *Error! Reference source not found.* sections) for details on configuring and setting the error condition and error action.

The following illustration indicates how the **Monitor** has been integrated in the Virtual Machine members.

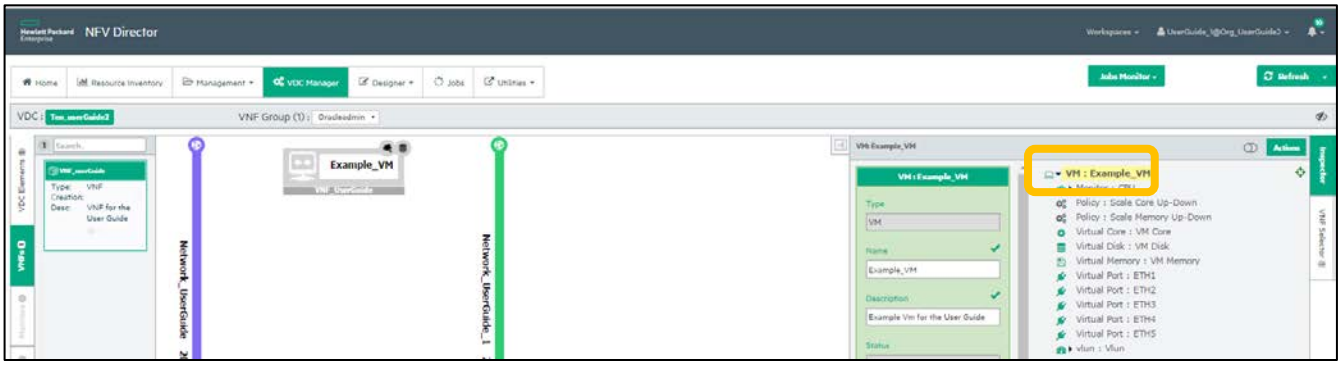


Figure 256: New Monitor in the Virtual Machine

2.1.7 Storage operations

This section describes how to configure and edit **VLuns** in the **VNF Designer** if the **VLun** menu is not disabled.

A **VLun** is a storage component. A **LUN** is a unique identifier for a physical storage allocation that can reference an entire RAID set, a single hard disk or partition, or multiple disks or partitions. The **VLun** does not map to a specific device or allocation of storage space but a virtual space that can be created in excess of the actual physical space available.

Follow these steps to create a **VLun** from the **VDC Manager**.

1. Position the cursor in the left region of the **VDC Manager**.
2. Left-click **Storage** in the vertical list.

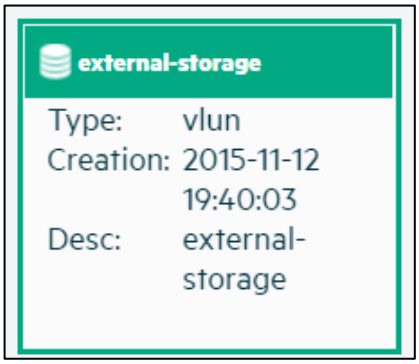


Figure 257: VLun element

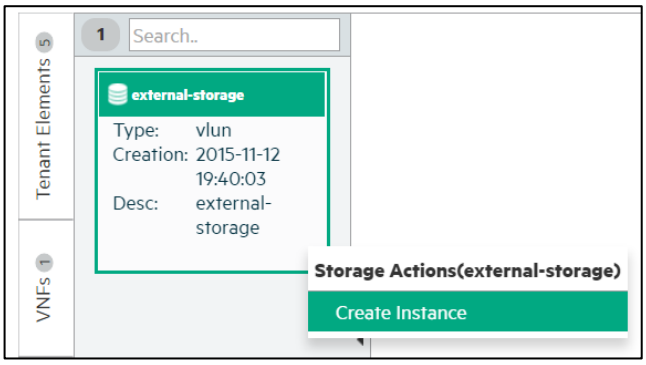


Figure 258: VLun Create Instance action

There are two ways to create a VLun.

- Drag the element to the workspace.
- Right-click the previously selected element and select **Create Instance**.

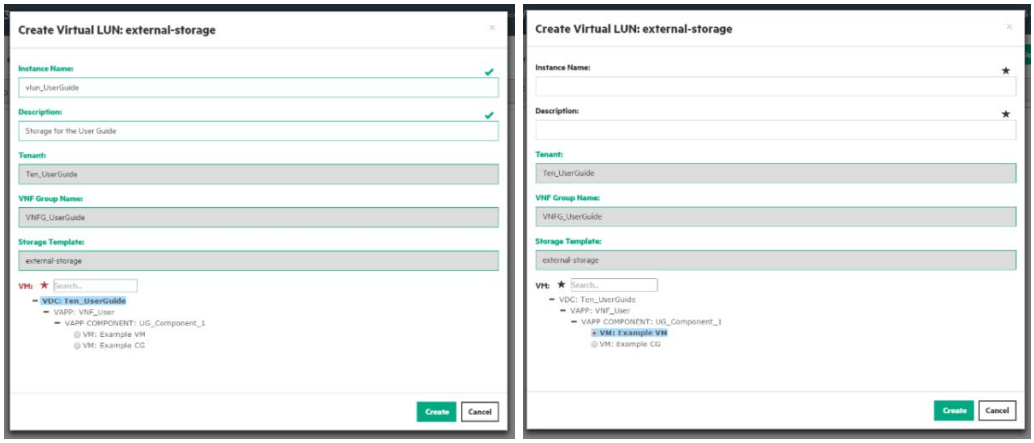


Figure 259: VLun creation configuration

The **Instance Name** and **Description** fields were completed with the **vlan_UserGuide** and **Storage for the User Guide** values respectively. Besides these attributes, the attribute referring to the monitor target needs to be completed. As indicated in the previous left-side illustration, the application will not allow selecting anything other than the Virtual Machine. In this case the target is one of the user-created Virtual Machines in the VNF, **Example VM**. Left-click **Create** to create the **VLun** or left-click **Cancel** to discard the changes.

IMPORTANT: In case of a Helion Carrier Grade (HCG) environment there must be at least one VLun with the following attributes set:

- **STORAGE.Bootable** attribute set to **true**, making the VLun bootable
- **INFO.Amount** attribute set to **0**

If these values are not set accordingly, the HCG environment will develop an internal conflict. Proper operation requires storage to be configured. Machines deployed in an HCG environment without properly configured VLuns will not operate as expected.

2.1.8 Heal operation

Sometimes a VNF or some VMs of a VNF do not operate properly or could be damaged. NFVD has a special **Heal** operation, which allows the execution of a specific workflow to heal the VNF.

The **Heal** operation can be triggered from two different levels:

- VNF level
- VNF component level

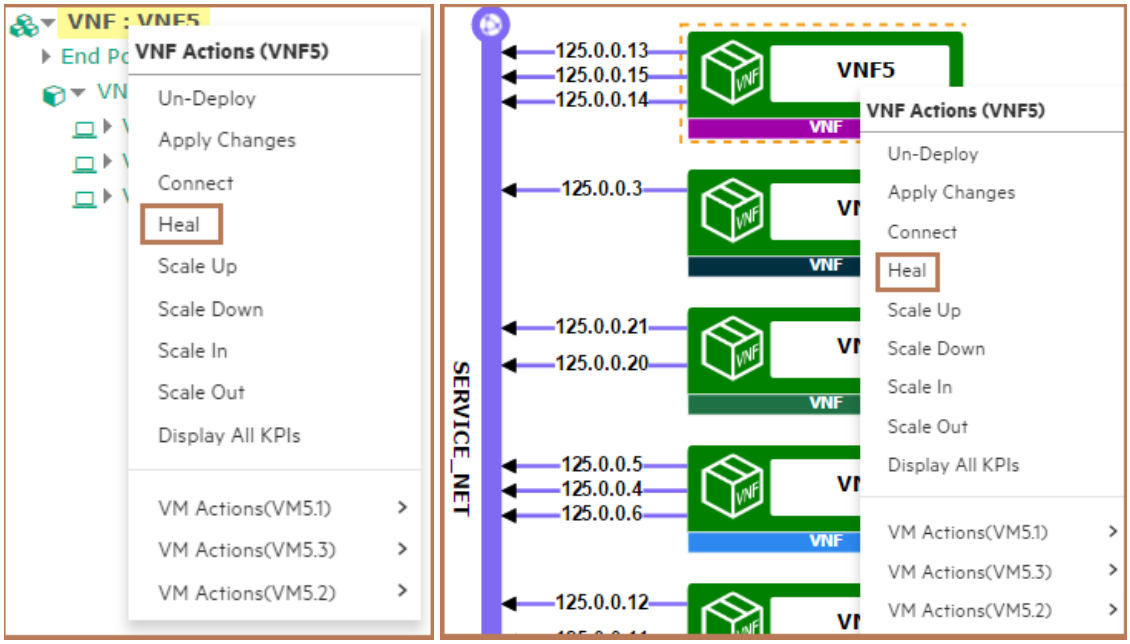


Figure 260: Heal operation at the VNF level

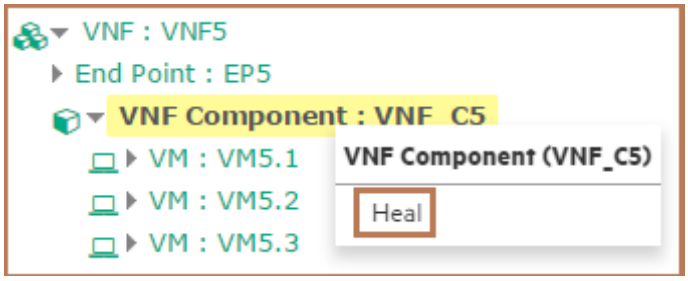


Figure 261: Heal operation at the VNF component level

The prerequisite for the **Heal** operation:

- VNF or vnf_component is deployed.
- VNF or vnf_component is created with Heal polices.

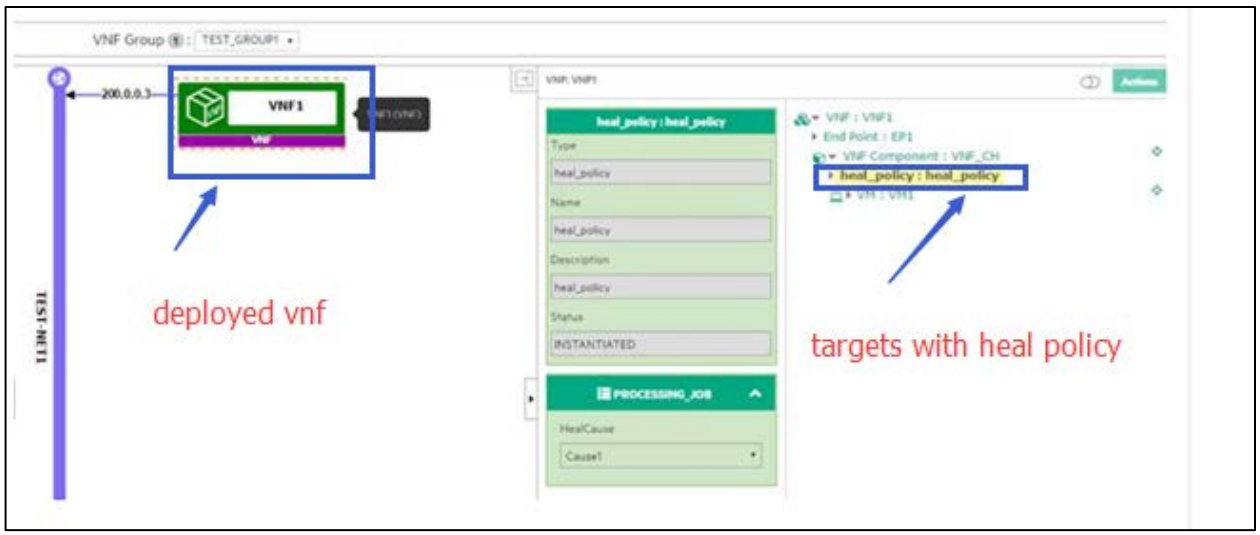


Figure 262: Deployed VNF

When selecting the **Heal** action, the cause needs to be selected. Possible values depend on the Heal policy attached to the VNF.

Figure 263: Selecting the Heal cause

The system displays a confirmation message after the **Heal** operation has completed successfully.

Figure 264: Heal operation confirmation message

The system will display the following message if there is no available **Heal** cause.

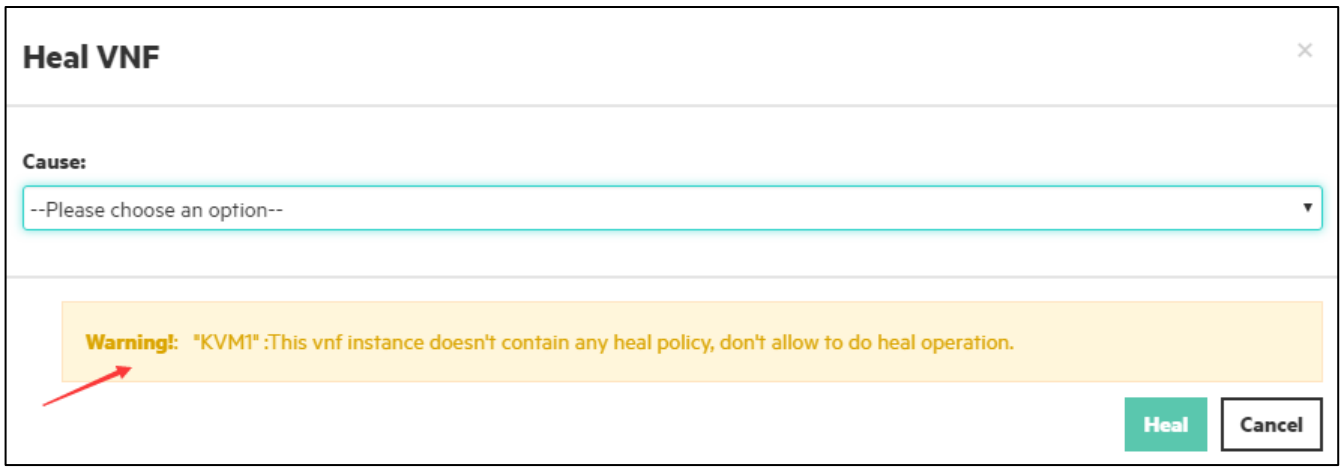


Figure 265: Missing Heal cause error message

Chapter 3 NFV Director Online Designer

3.1 VNF Component Designer

3.1.1 Introduction

The VNF component designer is an online designer implemented in our NFV Director platform. It allows us to design and modify the attributes and specifications of the VNF components that are going to be used later. To access the designer, go to the top menu of the NFV Director Web, and right-click **Designer**. From a list of two elements, select **VNF Component Designer**.

To use all the functionalities of the Designers at our disposal, we are accessing the NFV Director platform with a VDC level User.

3.1.2 Screens of the designer

3.1.2.1 Template chooser

After entering the valid credentials and selecting **Component Designer** in the top menu, you are going to see the following screen:

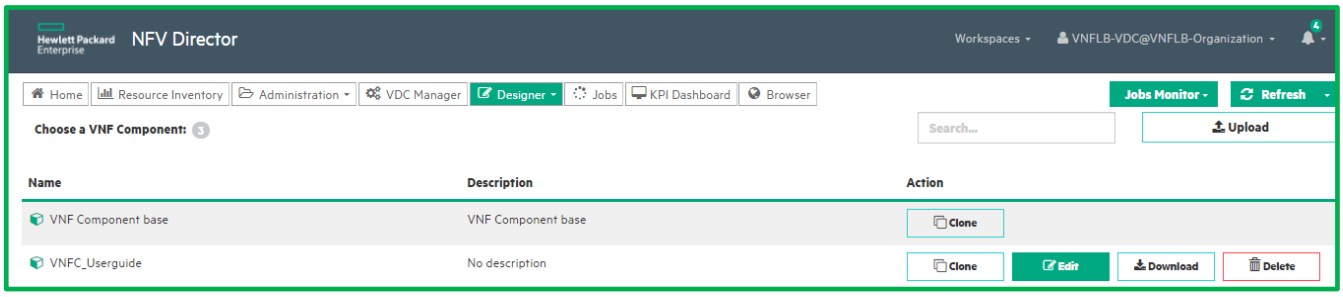
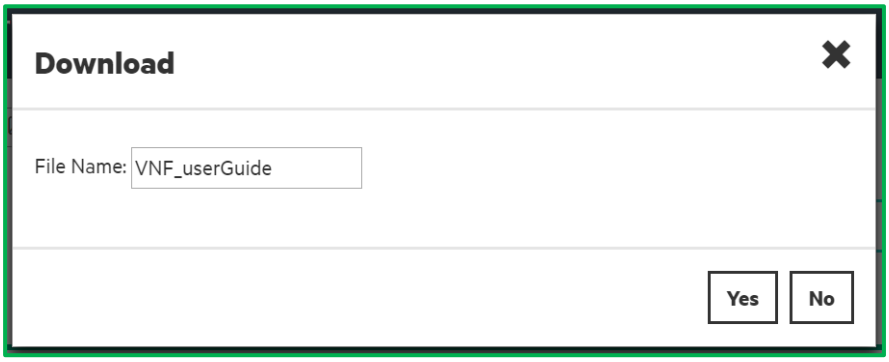


Figure 266: First window of the Component Designer.

The **Download** button allows us to get the file of the component of our selection. The design is exported to an .xml file. To download the design, click **Download** next to the component chosen. A new window appears, allowing to choose between the two types of files. It also allows the user to change the name of the design.



To execute the download, click **Yes**. In the case of the above image, once we click in the button, an xml file will be downloaded with the name `VNFC_UserGuide.xml`.

In this version, we can upload an already designed and functional VNF, have stored locally. To upload a new element to be edited with the designer, click **Upload**. A new window appears:

The upload only accepts xml files. After clicking **Import** a new file explorer window appears. Choose the file to upload. After selecting it, click Ok in the file explorer window. After that, click **Yes** in the upload window. Once the new element is uploaded, it will be listed in the **VNF Designer** list of VNFs available.

To continue, we need a template for our future component. To have a standardized starting point for all future components, first we need to clone the `VNF Component Base`. This element has the logical structure needed to build our VNF. To perform the cloning, right-click **Clone** in the right side of the page.

After right-clicking **Clone**, the designer is going to appear with all its sections.

In this screen, we have a list of all the possible component base for the creation of a VNF component. In this user guide, we are taking the easier way to make the tool easier to understand.

3.1.2.2 Main Screen of the Component Designer

The main screen of the Component Designer has five main zones. We are going to explain the different parts from the top to the bottom of the page.

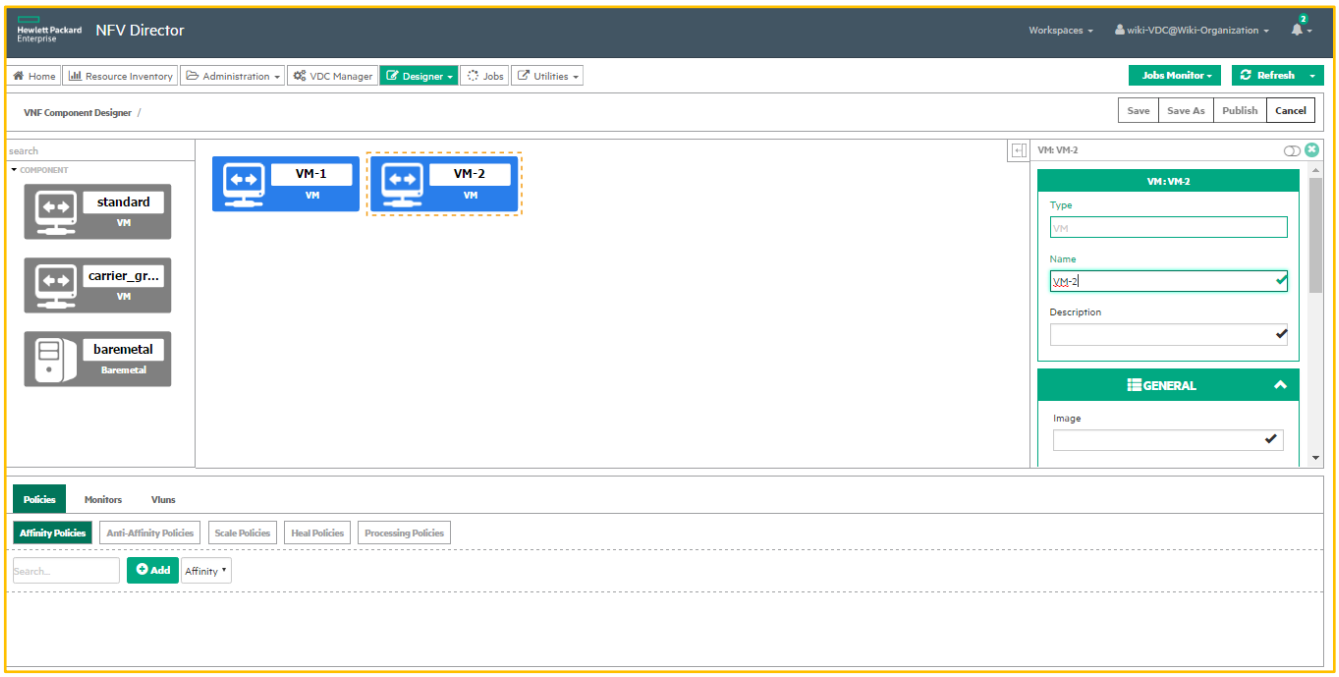


Figure 267: Main window of the Component Designer

Just under the top Menu of the NFV Director Web, we can see the beginning of the Component Designer. The first element on the top includes the name of the tool in use on the left, in this case, VNF Component Designer". This element contains usual options to save/cancel/publish our design on the right. The **Publish** option refers to the action of making the designed component usable for the creation of a VNF element. To publish an element, save it in advance.

Figure 268: Top menu of the Component Designer.

The center part of the page harbors three of the five parts of the Component Designer. The parts are described from the top to the bottom. The Component list and the Search tool on the left side of the Component Designer, we can execute searches for other components that are listed. In this case, we only have listed two possible components: a "standard" Virtual Machine, and a "carrier_grade" VM. If our NFV Director platform detects more components suitable to be used in a VNF, they are listed in this section.

The middle of the web page is the work place of the designer. If we select a component of the list and drag it to the center of the web page, the component will be created and will appear in this space. This way, it is possible to edit and customize the component. When all the elements are created, and we want to see all the components listed, it will be enough to select the work space to see the list on the right side of the designer. To select work space, click in an empty zone of the work space.

The fourth part of the Component Designer is located on the right side of the web page. This is where we can edit our components, by changing the different values of the attributes in each category. Some of these attributes are not editable, because they were set at the creation of the component to make sure that the value of the field is adequate, and to avoid future problems. Another possibility is that the values will be editable in another phase of the component. Notice the element in the top right corner of the field:  This button permits to edit and consult all the elements of the component that have been created, or the component that is just about to be created.

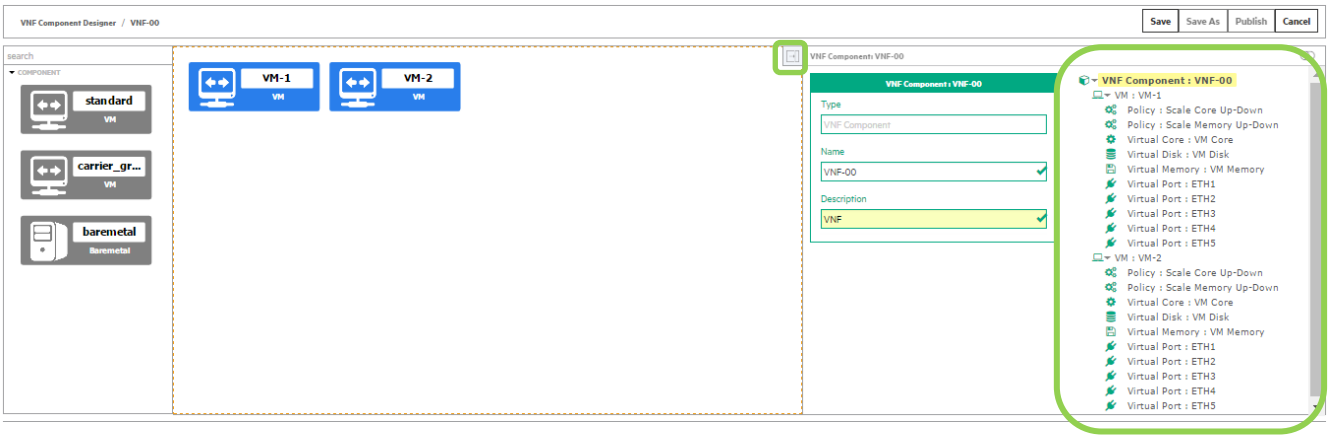


Figure 269: Attributes list in the Component Designer

The fifth part allows us to add and modify and include policies, monitors and VLuns. Creating and assigning each element will be explained later in the document.

Figure 270: Secondary elements menu in the Component Designer

3.1.3 Creation of elements for the component

To create new components for our future VNFs, open the designer and select the component to create or edit from the second part of the designer (as explained before). In this part, we have the list of possible components suitable to become a part of our VNF.

For example, to create a component Virtual Machine standard, select the component in the left side of the NFV Director Web Component Designer, and drag the future component to the work space in the center of the web page. The results should look like the below:

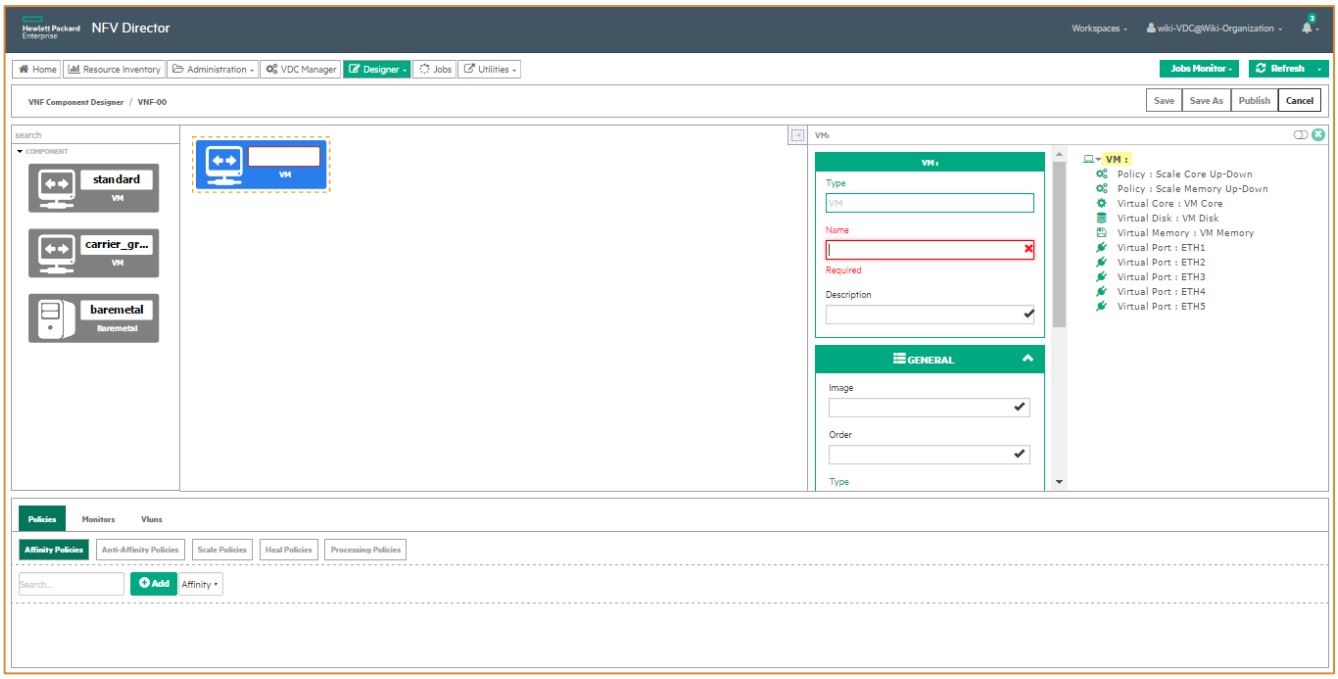


Figure 271: Creation of elements in the Component Designer, first stage

Notice that the elements active in the work space are colored in blue. Also, notice that in the fifth part of the Designer. in the bottom of the page, we can see two news sections, Monitors and Vluns. Monitors allows for the creation of different types of monitors, Vluns fulfills the storage needs of the component.

When selecting an element in the design area, the associated "inspector" is opened on the right of the page. It lists all the visible attributes of the elements. These attributes can be modified before the template is saved.

Some fields in the inspector are mandatory parameters that must be filled before the component is saved and published.

If we scroll down in the inspector of the component Designer, we can see the rest of the editable attributes of the element selected, in this case, a VM. We should at least fill the attribute Name with a correct value to continue with the publishing of the element.

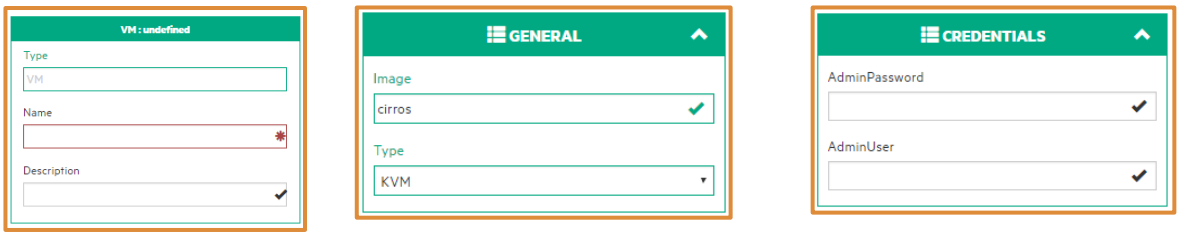


Figure 272: Different categories views from the Component Designer

These are examples of how the designer allows for the editing of the different categories of the element. In this case, the categories are `GENERAL`, `CREDENTIALS` and the one inherent most the elements that reflect `Name`, `Type` and `Description`. The fields that are marked with a ✔ have valid values for the attribute, and can also be edited depending on the needs of the user. The values in a field with the same symbol, but with transparent text are non-editable attributes. The attributes that are not in red, and do not have any symbol associated are free to edit. This means that they are going to be needed in some processes, but not in all the possible processes (like mandatory parameters).

To change any of the editable fields of any of the element's attributes, select the element, and change the value of the attribute. To make this changes effective, save the element. To enable the use of the saved element by other components, publish the element.

The next step in the creation of a component is assigning the policies, monitors and storage. All these actions take place in the fifth section of the Component Designer. When we open the Designer, we can see the **Policies** element at the bottom of the designer. This element is used to create three kinds of policies, Affinity, Anti-Affinity and Scale. These policies should be added as per the needs of the user. Not all the policies are always necessary, and it is possible that the policies have different values in their attributes.

If a component is being edited, in the section mentioned above, we are going to have at least two more sections: **Monitors** and **VLuns**. The monitors were introduced previously, and the Vluns are elements associated with the storage space needs of the component.

To summarize it: To create a component, drag the component from the list of components to the space of work in the center of the Designer. Once it is there, edit it if necessary by changing the attributes of each element in the component. Once done with editing the attributes, add Policies, Monitors and Vluns, if needed.

To delete some element of the designer, select the component and hit **Del** on your keyboard. If we use the **Cancel** button in the first section of the Designer, we are going to delete the component that we are working with. It can be a huge mistake if you are working with a complex component.

3.1.3.1 Creating a "standard" Virtual Machine

The creation of a standard "Virtual Machine" component begins with the selection of the component from the list of possible elements in the second part of the Designer. This is the list on the left side of the web page. As explained before, this list contains the valid elements to be integrated in the future component.

After selecting the element, drag it to the work space and wait for its creation.

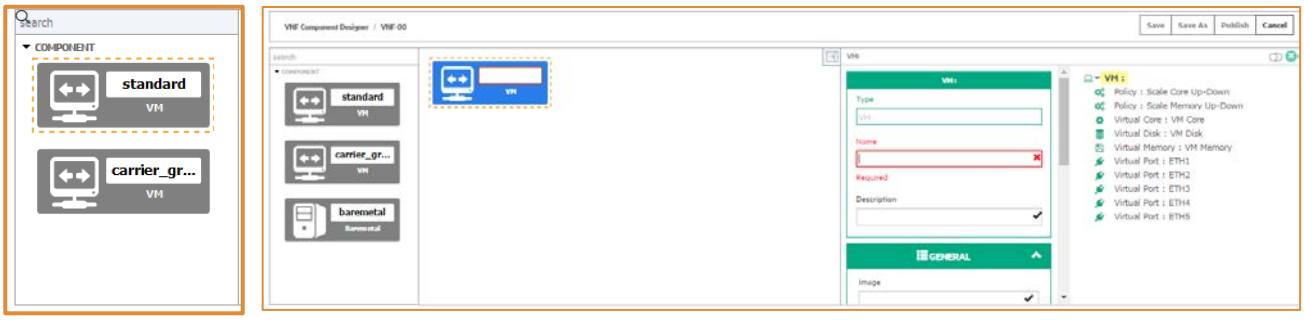


Figure 273: Creating a Standard Virtual Machine

As you can see in the images above, we selected the element `standard Virtual Machine`, we dragged the element to the work space, so the element has been created and has been colored in blue. As you can see, all the attributes and internal elements of the component are in the list on the right of the designer. Also, you can see how the designer requires the field `Name` to be filled, as it is a mandatory field. It will be filled with the value `Example VM`.

In the above image, on the right side of the designer, we can choose and change the value of some of the attributes present in the elements listed. Inside our Virtual Machine, we have policies, Virtual Ports, Virtual Core, and so on. All these elements are editable within certain constraints. If you select one of these attributes, you will see how the component window changes, and it displays the attributes of the element selected.

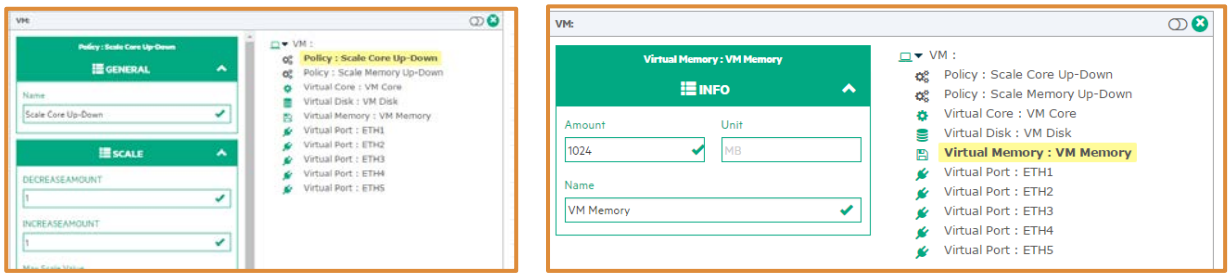


Figure 274: Editing the attributes of a standard Virtual machine

As you can see, the window that allows to edit the attributes will change with the element selected in the list. Once we finish the creation and the modifications needed by the component, we will proceed to assigning policies, monitors and storage. This part of the creation is common to all the elements, so it will be covered in another section.

Once we have created the element, we can edit the attributes and components of the element. We are going to introduce a new name for our Virtual Machine. To do that, we select the element in the work space by clicking it, and then we click in the field "Name" on the right side of the work space. After that, we type the new name for the VM, in this case `Example VM`.

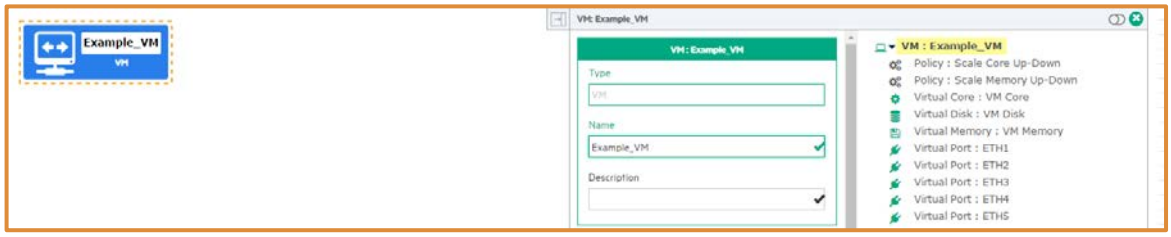


Figure 265: Introducing a new name for our standard Virtual Machine

To properly configure our Virtual Machine, that is, to make it behave correctly during the future execution, we need to fill all the attributes in all the categories until the green tick appears on the right side of the box.

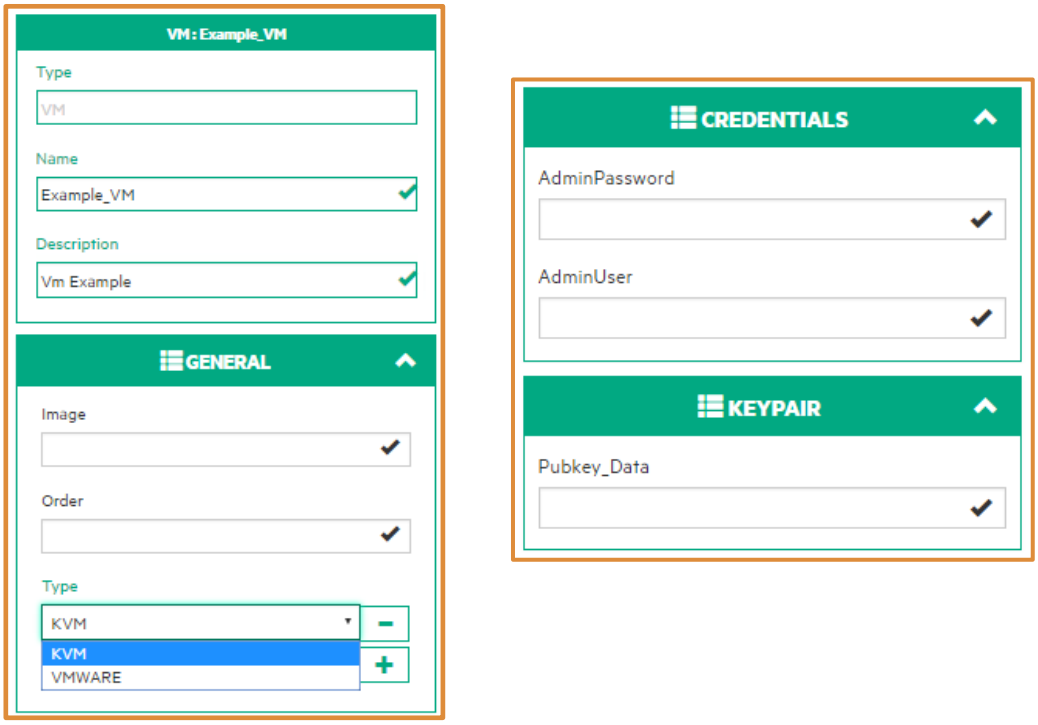


Figure 275: Editing the attributes of a standard Virtual machine

In this example, we have filled the attributes `Name` and `Description` with the values `Example Vm` and `Vm Example`, respectively.

To change the values of the attributes, click the attribute and edit the field.

In the `GENERAL` category, the attribute `Image` is filled with the value `cirros`. This can be changed if the user wants to aim to another image. The attribute `Type` can only take two values. `KVM` and `VMWARE` refer to the type of the image given in the previous field.

The `Order` attribute will designate the activation order of the machine. If more than one machine exists in the component, this attribute will be used during deploy, undeploy and scale operations, and every process that the solution can develop.

The `CREDENTIALS` category contains the attributes `AdminPassword` and `AdminUser`. These fields contain the access information for the Virtual Machine that we are configuring. `AdminPassword` and `AdminUser` are the values of the fields necessary to access the VM once activated. They are not mandatory.

The `KEYPAIR` category contains data needed to connect with the Virtual Machine that was recently activated by SSH. If the user fills the `Name` and `PubKey_Data` fields, they will be set in the current `KEYPAIR` as new values for the attributes.

The Default attributes of a Standard Virtual Machine are:

- Virtual Machine type: `"KVM"`.
- 5 Virtual Ports of type `"virtio"` to be used at disposition.
- 1 Virtual Port of type `"virtio"` and `"NetworkType" :"MANAGEMENT"`, to be used by the Management Network.
- 1 Virtual Disk, with `"Controller type": "SCSI"`, and an `"Amount"` of 1 Gb.
- 1 Virtual Core:
  - `CORE_ARCHITECTURE : "shared"`
  - `NUMA_ID: empty.`
  - `SHARED_VCPU: empty.`
- 1 Virtual Memory:
  - `Amount : 1024.`
  - `PAGE_SIZE : 2048.`

Depending on the conditions of the operation over the Virtual Machine, we should configure the attributes above to have a correct execution. We may encounter platforms that will not accept an activation of a Virtual Machine with a `CORE_ARCHITECTURE` other than `"shared"`. To have a successful execution, we should configure our VM in line with the platform and scenario that we are going to use. Generally, we need to focus on the attributes `CORE_ARCHITECTURE`, `NUMA_ID` and `SHARED_VCPU`. It is also necessary keep in mind that the attributes mentioned above could have validations, where the three of them will have specific values.

Note that a component may have more than one element in the list on the left side of the web page. This way, we have the possibility to create components with more than one Virtual Machine.

3.1.3.2 Creating a “carrier_grade” Virtual Machine

The creation of a component “Virtual Machine carrier_grade” begins with the selection of the component from the list of possible elements in the second part of the Designer. This is the list present in the left side of the web page, as explained before, this list contains the valid elements that can be integrated in the future components.

After selecting the element, drag the element to the work space and wait for the creation.

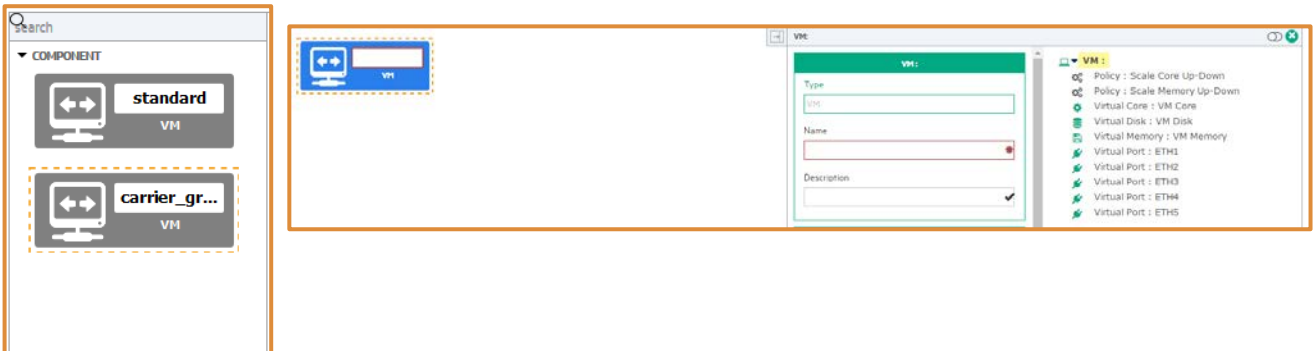


Figure 276: Creation of a Carrier Grade Virtual Machine

As you can see in the images above, we selected the element (standard Virtual Machine), and dragged the element to the work space. The element has been created and has been colored in blue. As you can see, all the attributes and internal elements of the component are in the list at the right of the designer. Also, you can see how the designer requires the field `Name` to be filled, as it is a mandatory field.

After creating the element, we can edit the attributes and the element's components. We are going to introduce a new name for our Virtual Machine carrier grade. To do that, we select the element in the work space by clicking it and then click in the field `Name` on the right side of the work space. After that, type the new name for the VM. In this case, it is `Example CG VM`.

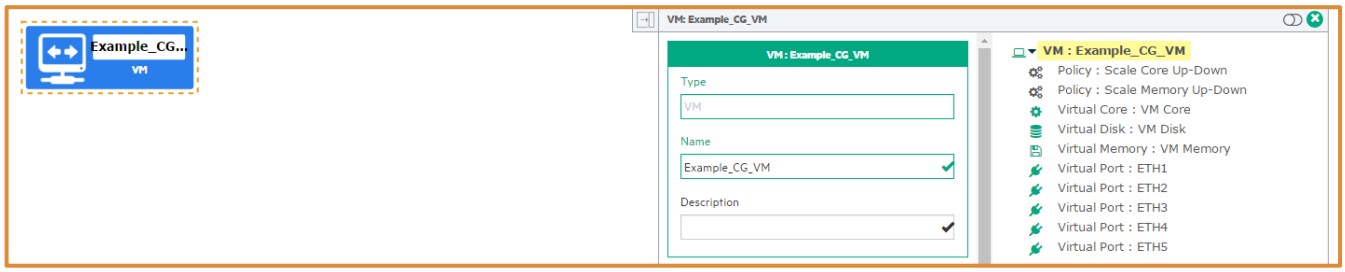


Figure 277: The attributes of a CG Virtual Machine

In the above image, on the right side of the designer, we can choose and change the value of some of the attributes present in the elements listed. Inside our Virtual Machine, we have policies, Virtual Ports, Virtual Core, and so on. All these elements are editable within certain constraints. If you select one of these attributes, you will see how the component window changes, and it displays the attributes of the element selected.

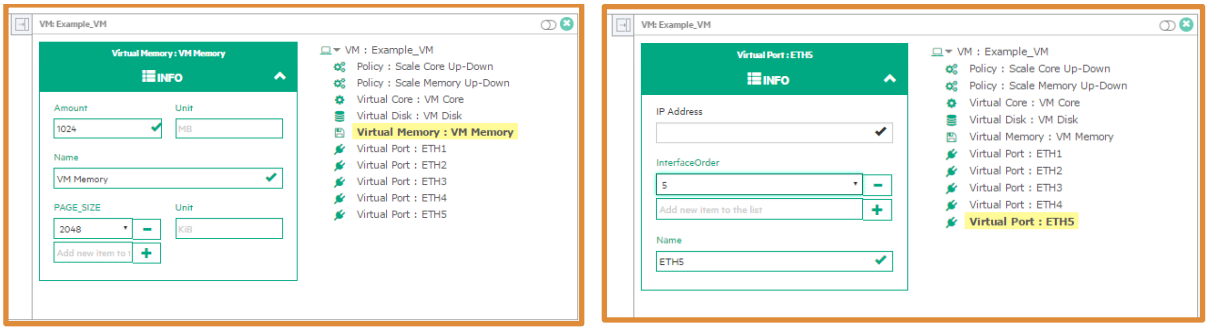


Figure 278: Edition of the attributes of a CG Virtual machine

As you can see, the window that allow us to edit the attributes will change with the element selected in the list, once we carry out the creation and modifications needed by the component, we will proceed to the assignation of policies, monitors and storage, this part of the creation it is common to all the elements so it is going to be relegate to another section.

The Virtual Machine Carrier Grade has some peculiarities over the "standard" VM. This is because the VM CG are components set up to be deployed in a specific `REGION:OPENSTACK`. A VM Carrier Grade needs to be related to a VIM carrier grade, or it will result in an error or incompatibility with the VM. The rest of characteristics come from the attributes, in a VM CG, the category INFO is going to have the `PAGE_SIZE` attribute present, responsible for setting the memory size in the machine. Also, the Virtual Core associated to the VM is going to have two more attributes in its `INFO` category: `CORE_ARCHITECTURE` and `NUMA_ID`. These attributes can only take two values. The possible values of

CORE_ARCHITECTURE are "shared" or "dedicated". By default, the value of the architecture is "shared". The possible values of NUMA_ID are "0" or "1". Both attributes will be validated during the assigning process. The combination of the values will determine how the assigning will take place.

The Default attributes of a Virtual Machine Carrier-Grade are:

- Virtual Machine type: "KVM".
- 5 Virtual Ports of type "virtio" to be used at disposition.
- 1 Virtual Port of type "virtio" and "NetworkType" :"MANAGEMENT", to be used by the Management Network.
- 1 Virtual Disk, with "Controller type": "SCSI", and an "Amount" of 1 Gb.
- 1 Virtual Core:
  - CORE_ARCHITECTURE : "shared"
  - NUMA_ID: "0".
  - SHARED_VCPU: empty.
- 1 Virtual Memory:
  - Amount : 1024.
  - PAGE_SIZE : 2048.

Depending on the conditions of the operation over the Virtual Machine, we should configure the attributes above to have a correct execution. We may encounter platforms that will not accept an activation of a Virtual Machine with a CORE_ARCHITECTURE other than "dedicated". To successfully execute a specific operation over a VM, we must make be sure that is properly configured, and it is not going to trigger an error. The main attributes to consider are CORE_ARCHITECTURE, NUMA_ID and SHARED_VCPU.

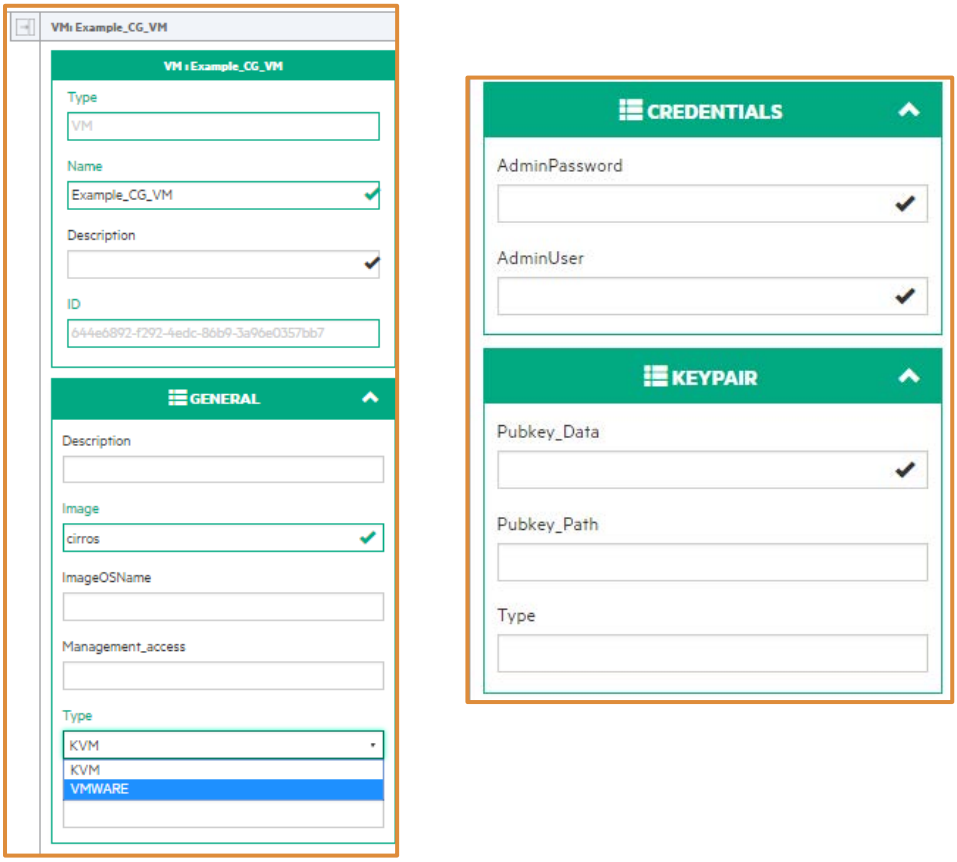


Figure 279: Editing the attributes of a CG Virtual machine

In this example, we have filled the Name and Description attributes with the values Example CG and VM CG, respectively. To change the values of the attributes, click the attribute and edit the field.

In the `GENERAL` category, the attribute `Image` is filled with the value `cirros`. This can be changed if the user wants to aim to another image. The attribute `Type` can only take two values, `KVM` and `VMWARE`, which refer to the type of the image given in the previous field.

The `CREDENTIALS` category contains the attributes `AdminPassword` and `AdminUser`. These fields contain the access information for the Virtual Machine that we are configuring. `AdminPassword` and `AdminUser` are the values of the fields necessary to access the VM once activated. In this case, the values are both `root`. This is set in the VM CG by error.

The `KEYPAIR` category contains data needed to connect with the Virtual Machine that was recently activated by SSH. If the user fills the `Name` and `PubKey_Data` fields, they will be set in the current `KEYPAIR` as new values for the attributes.

To make the element eligible to be part of a VNF, save it first. To do that, click **Save** in the first section of the designer. Note that before saving, the **Save As** and **Publish** options are not accessible. After saving the element, click **Publish** to make the element available for the VNFs.

3.1.3.3 Other attributes of a VM component

3.1.3.3.1 General.Order

The `General.Order` attribute allows the user to determine a specific order of activation for the VM when the deployment operation is being executed by NFVD. Additionally, the `General.Order` attribute allows the user to perform a specific order on the deployment and start tasks for monitors. When the deployment is being executed by NFVD, the `General.Order` attribute will be used with all the operations available in the solution, Scales, Deploys and Undeploy.

The following picture shows the user the attribute General.Order for VM and Monitor component

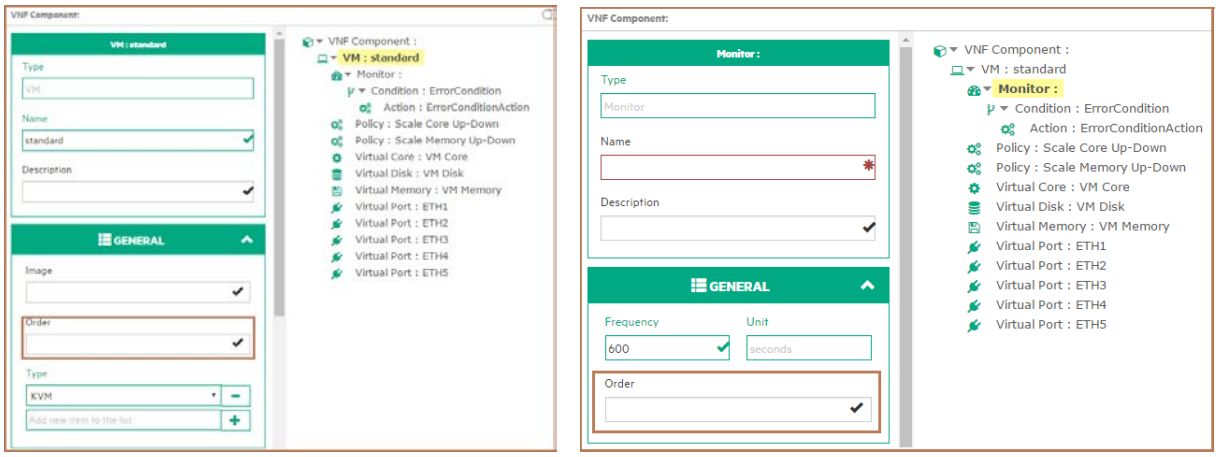


Figure 280: Editing the attribute General.Order.

`General.Order` works like an optional attribute. It means that the user can fill in the attribute or leave it empty on the UI. It depends on the behavior that the user wants to get from activation/deployment task in NFVD. Here we explain the behavior that the user can get from NFVD if they fill in the attribute, or if they leave the attribute empty. The following examples are related to a VM where the task affected is VM activation. If the user works with a monitor, the behavior of NFVD will be the same, in terms of order, but the task affected will be deploy and start monitor tasks.

- All VMs with `General.Order` attribute **empty.** The VMs will be activated in parallel.
- All VMs with `General.Order` attribute **filled**. The VMs will be activated step by step ordering the activation with the order given on each VM. NFVD supports **serial and parallel activation**.
    - Serial activation: imagine a deployment with three VMs where VM1 has order 1; VM2 has order 2 and VM3 has order 3. The activation of the second VM starts after VM1 is finished and so on
    - Parallel activation: imagine a deployment with four VMs where VM1 has order 1; VM2 and VM3 have order 2 and VM4 has order 3. The activation of the second and third VM is executed in parallel and starts after VM1 is finished. The activation of the fourth VM will start after VM2 and VM3 is finished.

- Some VMs with `General.Order` attribute **filled** and other VMs with the attribute **empty**. NFV Director will start with the activation of the VMs which have the attribute filled (following the rules given previously) and after that, it will continue with the parallel activation of the rest of the VMs.

Numeric or alphabetic order is supported by NFVD. It means that `General.Order` can be filled with numbers or words and NFVD will order the activation properly. The order of non-consecutive values is also supported, for example VM1 with order 2 and VM2 with order 8.

Also, the user should keep in mind that the `General.Order` will be taken into consideration also when the operations will be of type Scale, or during the Undeploy operation, not only in the deployments. During an undeployment operation, the logic that has been explained previously will act in reverse. The first VM to be undeployed will be VM2, followed by VM1.

The attribute `General.Order` can be filled or modified on VNF Component Designer, on VNF Designer, and also on VDC manager when the VNF template has been instantiated.

As the user knows, a VNF template can be built for different VNF components. In this situation, NFVD will be able to manage the VM ordering properly.

3.1.4 Adding policies to the component

We relegate this to another section due to the peculiarities of this elements and its assigning process. When we need to create a policy to be attached or connected to an element, we should have the element properly created and with all its attributes correctly filled. Also, we should know well which policies our element needs. Once we know and have what is needed, we can start the process of creation.

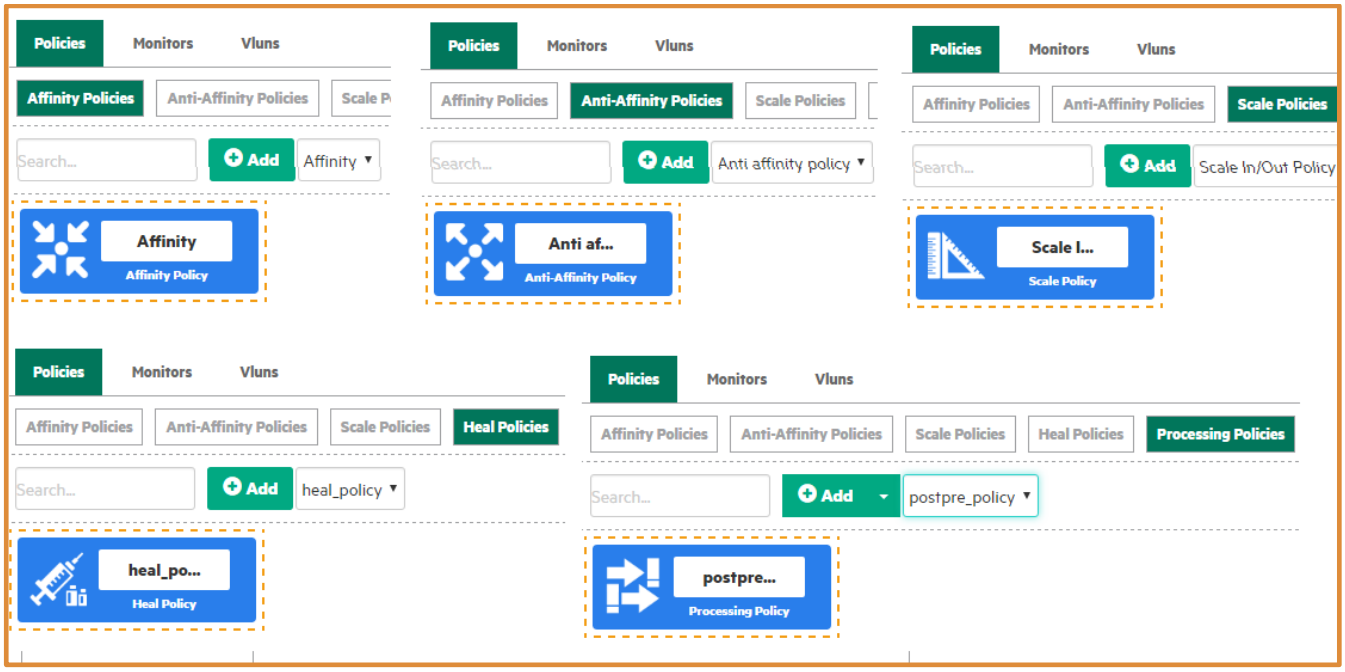


Figure 281: Types of policies available in the Component Designer

The designer allows us to create three types of policies, Affinity, Anti-affinity and Scales polices. Each one of them have some rules to take into consideration. These rules will be described in the following sections.

A Scale policy will only act over ONE element: a Scale Policy only develops its function over one element, a VNF component or a VNF for the Scale In/Out, and a Memory or a Core in case of the Scale Up/Down. It does not work for more than one element, a Scale policy applied over more than one element will develop its function only over one of the elements, the rest of the elements will remain unaltered.

The Affinity policies are elements that enclose the possible operation targets. This means the performing of operations in one `AVAILABILITY_ZONE` or another, and the `SERVER`s receive the same treatment.

3.1.4.1 Adding Affinity Policies

An Affinity Policy allows us to indicate where and over what artifact the assigning of resources is going to take place. When we create an Affinity policy of type `MUST`, and it is going to act on the Server's level, it is going to assign to the `SERVER:GENERIC` all the resources that will be needed for a correct behavior of the element.

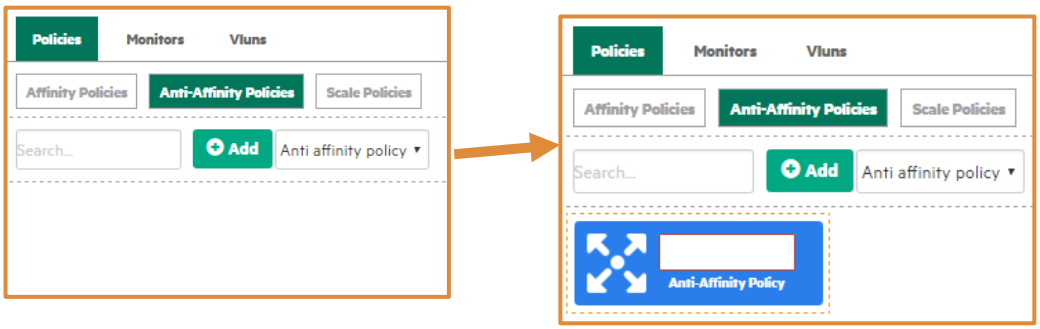
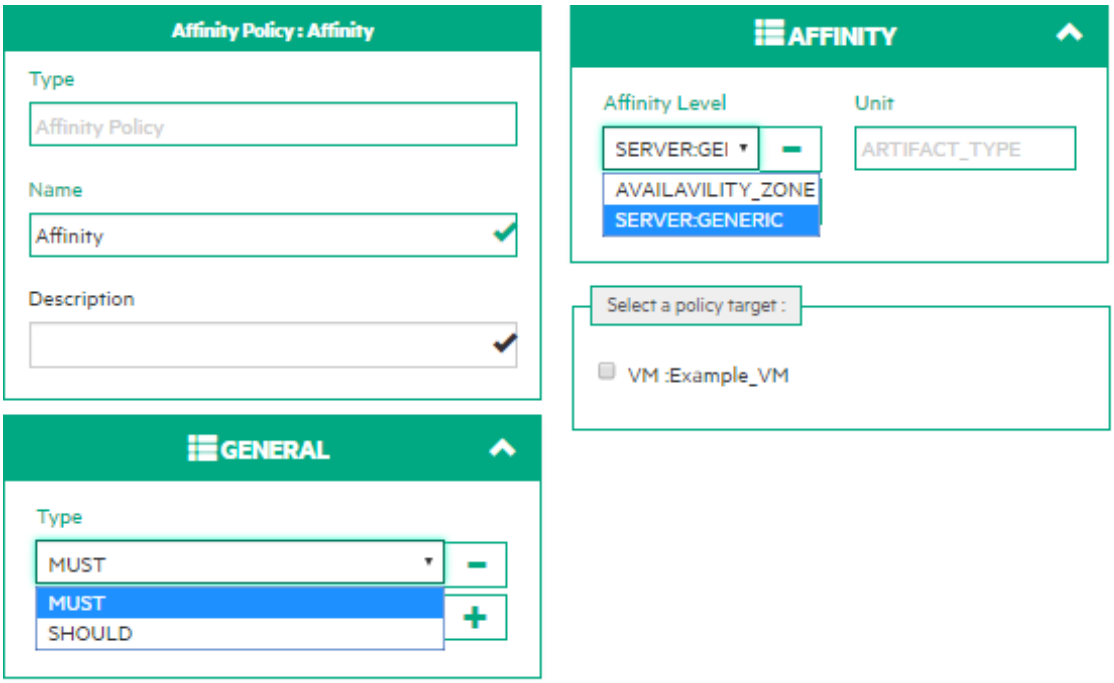


Figure 282: Adding an Affinity policy to a component

To create a new "Affinity Policy", we need to click the tag **Policies**, and then click **Anti-Affinities Policies** in the bottom left side of the web UI. After selecting these two tags, we will see a window similar to the image above on the left, depending on the theme on the platform. To create the policy, click Add. The policy will be created with the editable fields empty, as in the image above on the right.



For this policy, we set the `Name` with the value `Affinity Policies`, and the field `Description` with the value `Policy Affinity`. All the fields must be filled until the green tick is present in the right side of the box.

The difference between selecting `MUST` or `SHOULD` as the value for the `GENERAL.Type` is that in case we have selected `MUST`, if the system is close to running out of resources during the assigning, the application will throw an error message. If the value is `SHOULD`, the application will throw a warning message, and continue with the execution without stopping. In

this case, the value of the `Type` attribute is `MUST`, so if the resources available are close to be depleted in the moment of the assigning, the application will throw an error. In other case, the execution will continue.

Once we have chosen the `Type` of the policy, we should choose the Affinity Level. The affinity level only has two possible values: `SERVER:GENERIC` or `AVAILABILITY_ZONE`. These limitations respond to a control of the resources. If our policy is going to be used at Server level, this policy will be applied to that Server and only to that Server. If we choose the other option, our recently configured policy will be applied to all the servers below the Availability Zone chosen.

The last part of the creation of the Affinity policies is selecting the target of the policy. In this example, we only have one Virtual Machine to choose. Remember that we have only created a `VM Example`. If, in the previous section, we had created more than one VMs, we could select more than one VMs. We will select the unique Virtual Machine present in the list. Once we have configured the policy, we can continue creating the rest of the policies needed.

3.1.4.2 Adding Anti-Affinity Policies

An Anti-Affinity Policy allows us to indicate where and over what artifact the assigning of resources should not take place. When we create an Anti-Affinity policy of type `MUST`, that is going to act on the Availability Zone's level, it is going to avoid the assigning of resources in that Zone.

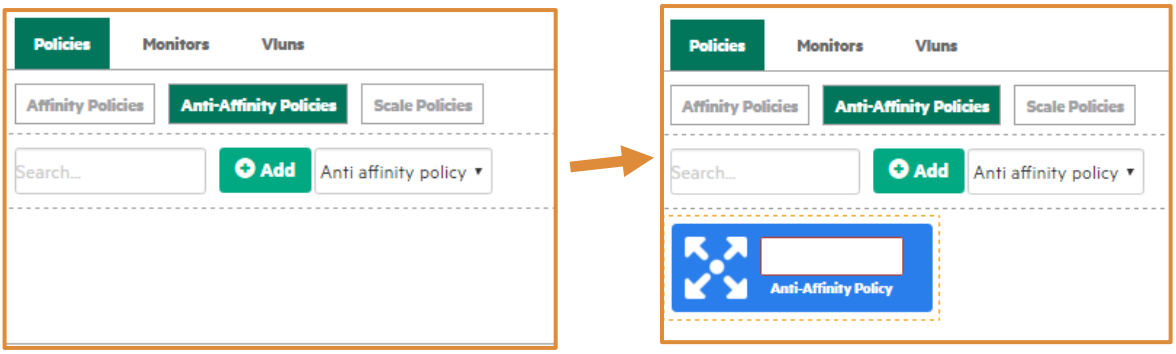
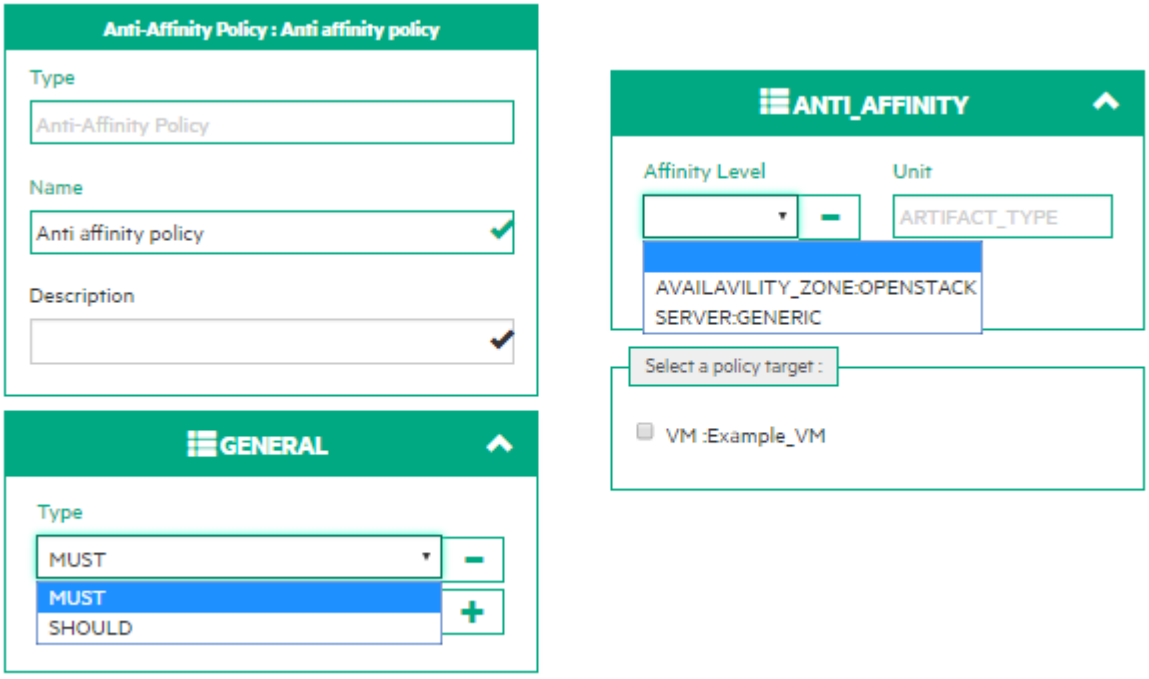


Figure 283: Adding an Anti-Affinity policy to a component

To create a new Affinity Policy, click **Policies**, and then click **Affinities Policies**, in the bottom left side of the web. After selecting these two tags, we will see a window like the image above on the left, depending on the theme on the platform. To create the policy, click Add. The policy will be created with the editable field empty, as in image above on the right.



For this policy, we set the `Name` with the value `Affinity Policies`, and the field `Description` with the value `Policies AntiAffinity`. All the fields must be filled until the green tick is present in the right side of the box.

The difference between selecting `MUST` or `SHOULD` as the value for the `GENERAL.Type` is that in case we have selected `MUST`, if the system is close to running out of resources during the assigning, the application will throw an error message. If the value is `SHOULD`, the application will throw a warning message, and continue with the execution without stopping. In this case, the value of the `Type` attribute is `MUST`, so if the resources available are close to be depleted in the moment of the assigning, the application will throw an error. In other case, the execution will continue.

Once we have chosen the `Type` of the policy, we should choose the Affinity Level. The affinity level only has two possible values: `SERVER:GENERIC` or `AVAILABILITY_ZONE`. These limitations respond to a control of the resources. If our policy is going to be used at Server level, this policy will be applied to that Server and only to that Server. If we choose the other option, our recently configured policy will be applied to all the servers below the Availability Zone chosen.

The last part of the creation of the Affinity policies is selecting the target of the policy. In this example, we only have one Virtual Machine to choose. Remember that we have only created a `VM Example`. If, in the previous section, we had created more than one VMs, we could select more than one VMs. We will select the unique Virtual Machine present in the list. Once we have configured the policy, we can continue creating the rest of the policies needed.

3.1.4.3 Adding Scale Policies

The Scale policies are a set of orders and presets that conduct and manage the escalation processes over the different elements of the system. To clarify what types of policies we use and which ones are the best options to be applied depending on the needs of the process, we will go over the scaling policies nature.

Scale Up:	Acts when a specific category's attribute of an artifact need to be dimensioned to an upper value, so this policy is going to act over elements as CPU or Memory.
Scale Down	Acts when a specific category's attribute of an artifact need to be dimensioned to a lower value, so this policy is going to act over elements as CPU or Memory.
Scale In:	Acts when an artifact needs to be eradicated in all its conditions and states. This type of policies permits the deletion of a number of elements, all of them equal to the artifact that acts as target of the policy.
Scale Out	Acts when an artifact needs to be cloned in all its conditions and states. This type of policies permits the creation of a number of elements, all of them equal to the artifact that acts as target of the policy.

When we create a Virtual Machine, in the moment of the creation, the element has two scale policies already created and related to the new VM. These policies are `Policy:Scale Core Up-Down` and `Policy:Scale Memory Up-Down`.

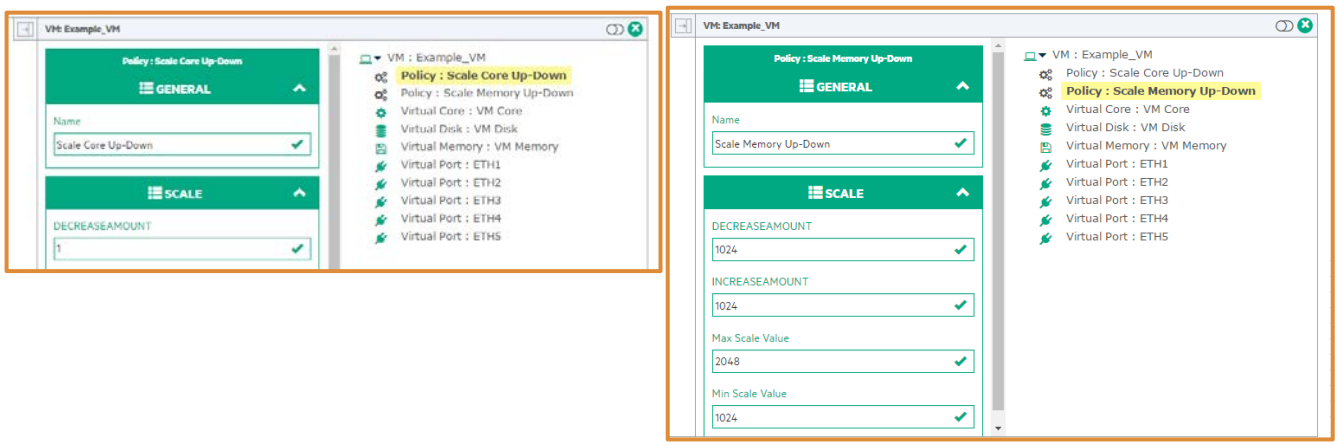
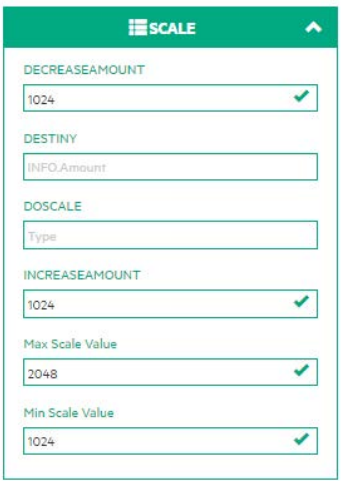


Figure 284: The Scale policy attributes

3.1.4.3.1 The Scale Up and Scale Down policies

`Policy:Scale Core Up-Down` is responsible for resizing the number the Virtual Machine's cores. If, for some reason, during the execution the Virtual Machine needs more Cores, the policy UP will start creating Cores until the number of cores reaches the `Max Scale Value`. Of course, if the VM needs less Cores, the policy DOWN will start. It is pretty much what happens with the same kind of policy, but applied to the Memory management. If needed, the policy `Scale Memory Up` will start, increasing the amount of Memory until the size of the memory reaches the value of the attribute `Max Scale Value`. The same dynamic but in opposite direction for the `Scale Memory Down` policy is, in this case, decreasing the size of the memory until it reaches the value of the attribute `Min Scale Value`.



`DECREASEAMOUNT:` The amount of unities that are going to be eliminated. For this policy, it will be erased of the memory. In this case, 1024 Mb.
`DESTINY:` The category and attribute that is going to be modified by the policy. In this case the "Amount" of memory in Mb, reflected in the category "INFO".
`DOSCALE:` Not editable by the user.
`INCREASEAMOUNT:` The amount of unities that are going to be enhanced. For this policy, it will be created for the memory. In this case, 1024 Mb.
`Max Scale Value:` The maximum amount of the specific resource that can be reached through a scale operation, in this case, 2048 Mb.
`Min Scale Value:` The minimum amount of the specific resource that can be reached through a scale operation, in this case, 1024 Mb.

Note that the Scale Up/Down policies are implemented by defect in the base components. Another important thing to have in mind before starting a Scale Up/Down operation is that the policy is going to act without knowing if the situation on the OpenStack platform can afford what is expected by the policy. This means that, to guarantee the escalation, the user should be sure that the resources present in the OpenStack platform are enough to carry out the escalation, the limitation of the resources in the OpenStack platform must be checked by the user.

3.1.4.3.2 The Scale Out and Scale In policies

The Scale Out/In policies are responsible for the creation or deletion of components. At this level, for a VNF Component, the scale Out/In policies are the ones that will create or destroy the Virtual Machines that conform the VNF Components. These policies can be set in two levels, between the VNF and the VNF Component, and, in our case, between a VNF Component and its Virtual Machines.

To create a new escalation policy over a Virtual Machine, first we should have a VM artifact in our work space (Third section of the Designer), with all its attributes and elements correctly filled. Once we have our VM, we need to go to the bottom of the web page, click **Policies**, and we will be able to see the below screen:

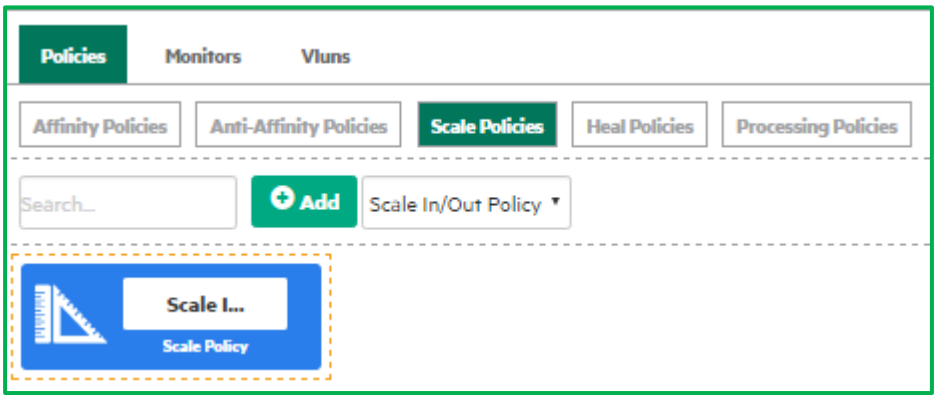


Figure 285: The creation of a Scale Policy

Once we see this screen, we can create the policy by clicking  . The next step is filling the attributes of the policy and setting the target and name for the policy.

We should keep in mind that **the escalation policies should be set at the proper level to get the desired effect**. We have two options to create the escalation policies: Creating the escalation policy at component level, and creating the policy at VNF level:

> *Component level*: When we set a Scale Out/In policy at this level, the escalation operation will be applied to the elements that conform the component. This means that the escalation is going to take place over the Virtual Machines of the component, only over these machines, and only over the original template of the Component. **The modifications over the instances will not be reflected in the escalated elements.**

For example, if we have a Component with One VM, and a Scale policy with an `Incremental Value` of 1:

- The user starts an escalation operation, the VNF Component will create another Virtual Machine cloning the one that already exists.
- At the end of the first escalation operation, the user will have two VMs over the same component.
- Later, this VNF Component needs to grow again and the user starts another escalation operation.
- When the process has finished, the user has three Virtual Machines, due to the escalation process is performed over the original design of the VNF Component, not over the result of the first escalation process.

> *VNF Level*: When we set a Scale Out/In policy at this level, the escalation will be applied over all the components of the VNF. So, if we configured an `Increment Value` of `1`, each component of the VNF will be duplicated by cloning one time. Basically, we will reproduce our VNF structure one time, including the Scale policies present in the VNF Components. These policies are going to be executed, too, when we trigger the escalation operation.

Notice that an escalation is never going to take place if the `Decrement Value`, `Increment Value` and the `Min Scale Value` are in conflict. The following cases clarify what we mean by conflict:

A `Scale Out` operation at VNFC level, because we will use number of Virtual Machines: if our policy was set at VNF level, we would talk about number of VNF Components, but the behavior of the policy would be the same.

Number of VM	Decrement	Increment	Min	Max	Conflict
1	1	1	1	1	`Min` and `Max` has the same value, no Scale Out will be performed due the number of VM already suits the `Max` value.
2	1	1	2	3	`Max` value is not enough to settle the amount of VM that the operation will create with and increment of one. Four VMs will be created, with a `Max` value of 3. No Scale out will be performed.
3	1	1	3	6	The Scale Out will be performed only one time. With this configuration, the Scale Out can only be executed once in a row.

We will implement our escalation policies for our VNF Component at the level that shown in the image below. It will only act over the `VM:standard`, which is part of the component.

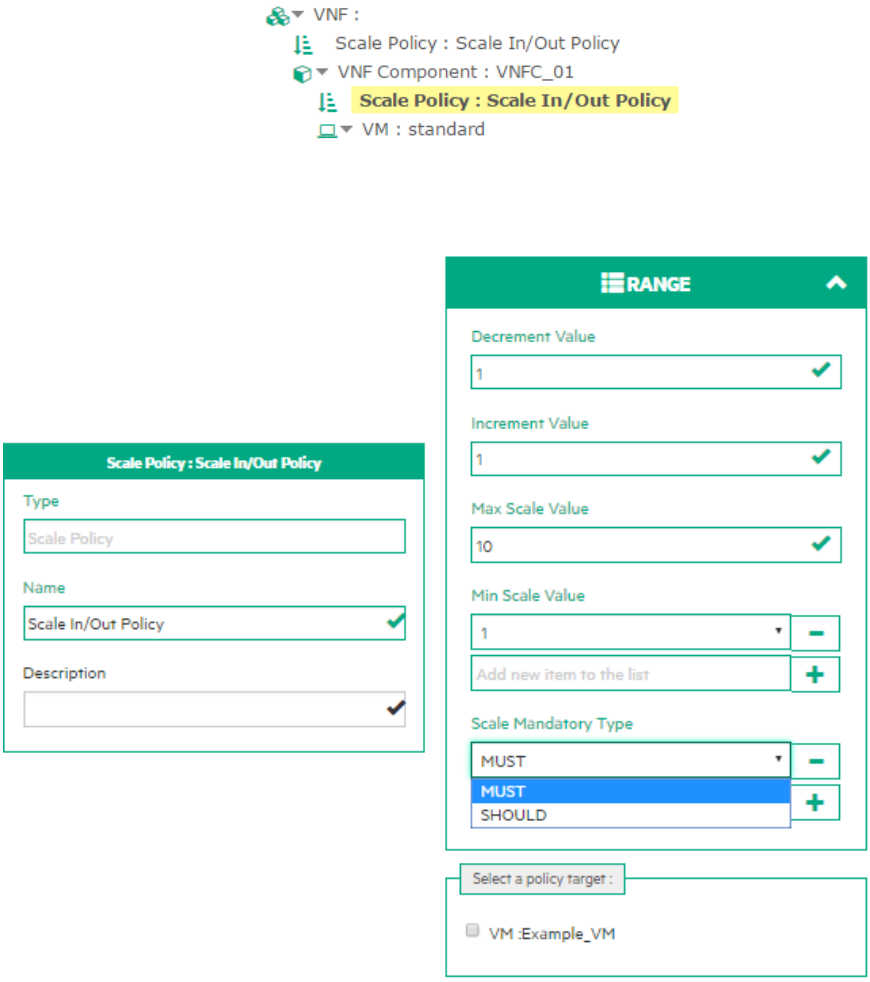


Figure 286: Editing the attributes of a Scale policy

For this policy, the fields `Name` and `Description` in the category `GENERAL` have been filled with the values `Scale Policy` and `Policy to scale VM` respectively. And in the category `RANGE`, we are going to construe the value in each field.

The `Decrement Value` and `Increment Value` are related to the number of VMs that are going to be duplicated or erased. If we have a value of `1` as decrement value, it means that in case of a `Scale IN`, the number of VMs that are going to be erased is only one. In case of increment, the logic to apply it is the same. For a value of `2`, if we have one VM, we will end up having three VMs. In case of having two VMs, we will finish with six VMs.

The difference between selecting `MUST` or `SHOULD` as the value for the `GENERAL.Type` is that in case we have selected `MUST`, if the system is close to running out of resources during the assigning, the application will throw an error message. If the value is `SHOULD`, the application will throw a warning message, and continue with the execution without stopping. In this case, the value of the `Type` attribute is `MUST`, so if the resources available are close to be depleted in the moment of the assigning, the application will throw an error. In other case, the execution will continue.

As target, we have selected the unique VM in the list, remember that if your component has more than one VMs, they are going to be listed there. To select other VM, it is enough to tick the box at the left of the artifact's name in the list.

3.1.4.4 Adding Heal Policies

A Heal Policy allows us to indicate a Heal cause, and to determine what workflow will be executed in NVFD when the user triggers the Heal operation over a VNF or a VNF component.

Heal policies can be used during the execution of the operations. These policies will take care of the heal cause, using the workflow that has been set in the policy while the operation is still working.

Figure 287: Adding a Heal policy to a component.

To create a new Heal Policy, click **Policies**, and then click **Heal Policies**, in the bottom left side of the web. To create the policy, click 

. The policy will be created with the editable field empty.

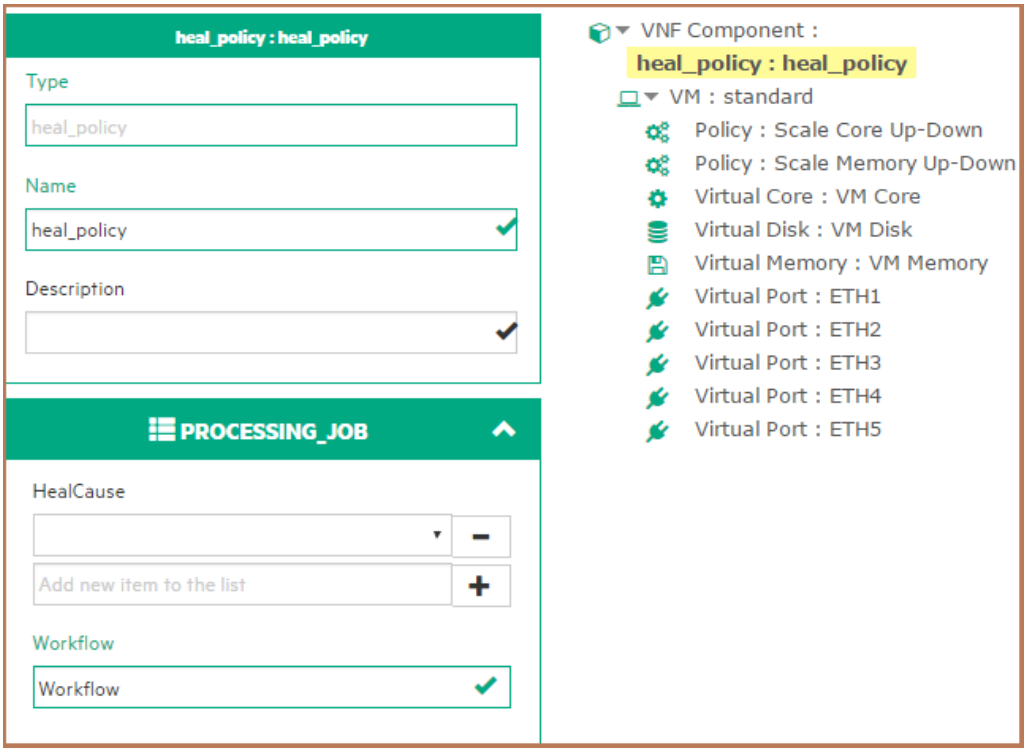


Figure 288: Editing the attributes of a Heal policy.

For this policy, we set the `Name` with the value `Heal_Policy`, the field `Description` with the value `Policies Heal`, the field `HealCause`, which is a list of values that allows the user to add new items, and the field `Workflow` with the name of the workflow that will be executed when NFVD triggers a heal operation.

3.1.4.5 Adding Pre/Post-Processing policies

Post-processing and Pre-processing policies allow us to execute a specific action before the operation starts (Pre-Processing policies) or after the execution of the operation is finished (Post-Processing policies). Such actions that should take place in a specific moment should be carried out by a Workflow. This workflow should contain all the logic needed for the action to achieve its goal. These actions could be closing a connection before the shutdown of a machine, or assuring a set of prerequisites before the launch of an operation. Basically, these policies modify the preceding and following scenario for our VNFs.

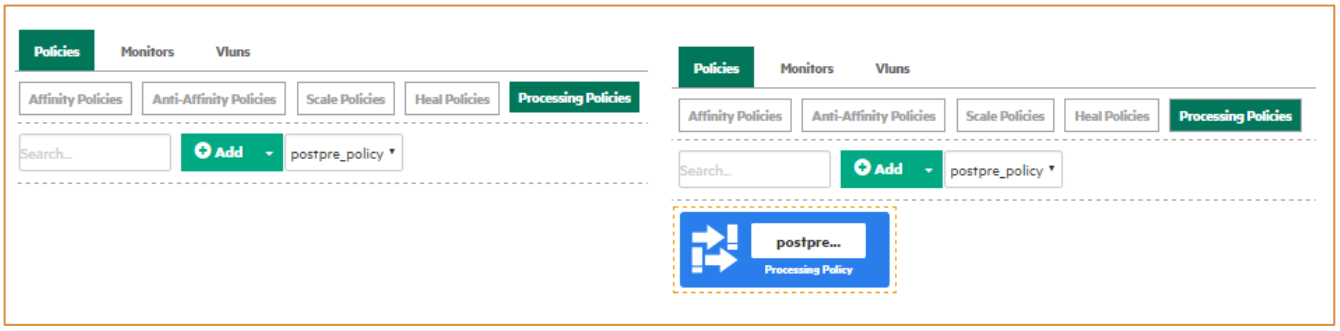


Figure 289: Adding Pre/Post processing policies

The image above shows how the Pre/Post processing policies are created. All the editable attributes are wrapped in the category `PROCESSING_JOB`. A Pre/Post-processing policy must have a workflow to be processed, and it should have an operation as target for the triggering of the policy. For these policies, it is also possible to identify an order of execution. A complex task could have more than one Workflow or process involved. We are going to explain what each attribute of the category `PROCESSING_JOB` is and how these attributes should be filled to have a successful use of the policy.

- Type: The type only can take two values: `PRE` or `POST`, corresponding with one of the two types of actions that will take place when the policy will be executed.
- WorkFlow: The policy needs an element that contains all the logic of the process that is going to be executed. This mandatory element is implemented through a Workflow that is customized for the specific operation. This means that a Pre-processing policy can have more than one workflow prepared to be executed. Each workflow will have a Pre/Post-processing policy assigned to be executed, so the same entity could have several Pre-Post policies related, but **entities cannot share their processing policies with each other**.
- Operation: The `Operation` attribute represents the operation from which the policy will be triggered. These operations are `Deploy`, `Undeploy`, `Scale Up`, `Scale Down`, `Scale In` and `Scale Out`, basically the core operations of the solution.
- OrderBy: This is a numerical attribute. We can introduce the order of execution that should be followed during the execution of the operation. If we have more than one policies related to the same operation, we can sort the execution introducing a number in this attribute. This way, if we introduce the number 2, our policy will wait for the first policy to be executed, and only after that will out policy start its execution.

3.1.5 Addition of monitors to the component

Monitors are elements that permit the user configure an observer for the element monitored. This means, that depending on how we configure our monitor, it will receive different information about the behavior and changes of the component monitored. This monitoring has the objective to react when the system is in need of some kind of resources, mainly solving this lack with the launching of escalation actions.

A Monitor must be connected and related to a Virtual Machine, If the user does not have a Virtual Machine already instantiated in the work Space (third part of the Designer), the Monitors tag it will not be shown as Active, so we are not going to be able to create a Monitor.

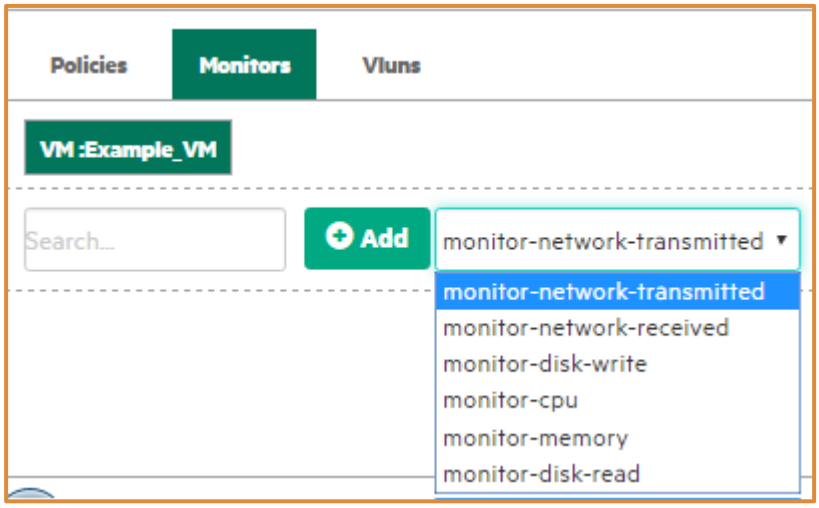


Figure 290: Types of Monitors available

If the user has properly created a Virtual Machine element in the work space, the user will be able to create a Monitor of the type listed in the image above. As you can see in the image, the Monitor (regardless the kind) will be created under the influence of the VM :Example_VM Virtual Machine. In the figure, we can see all possible types of Monitors that the application allows us to create. To create one type of monitor, select the type and click Add. This action will add a Monitor of the selected type to the Virtual Machine, and it will pair that monitor to the element determined by the Monitor's type. A monitor of type CPU will be matched with the CPU related to the Server used with the Virtual Machine in use.

3.1.5.1 Types of Monitors

All the attributes of a Monitor, from our point of view, are reduced to the `Name` and `Description` of the element. This is because we have already chosen the type and the element that is going to be monitored. The attributes that remain empty are those two previously mentioned. The other two important categories to configure are `Action` and `Condition`. The way to treat these categories is covered later in this chapter.

The types of Monitor we can deploy over our Virtual Machines are:

Monitor Disk Write:	Monitors writing operations over the Virtual Disk associated to the Server related to the Virtual Machine.
Monitor Disk Read:	Monitors reading operations over the Virtual Disk associated to the Server related to the Virtual Machine.
Monitor CPU:	Monitors operations over the Virtual CPU associated to the Server related to the Virtual Machine.
Monitor Network Transmitted:	Monitors transmission operations over the Virtual Network related to the Virtual Machine.
Monitor Network Received:	Monitors the messages received through the Virtual Network related to the Virtual Machine.

Monitor Memory:	Monitors operations over the Virtual Memory associated to the Server related to the Virtual Machine.

A Virtual Machine can have one type of Monitor per each kind of artifact related to it.

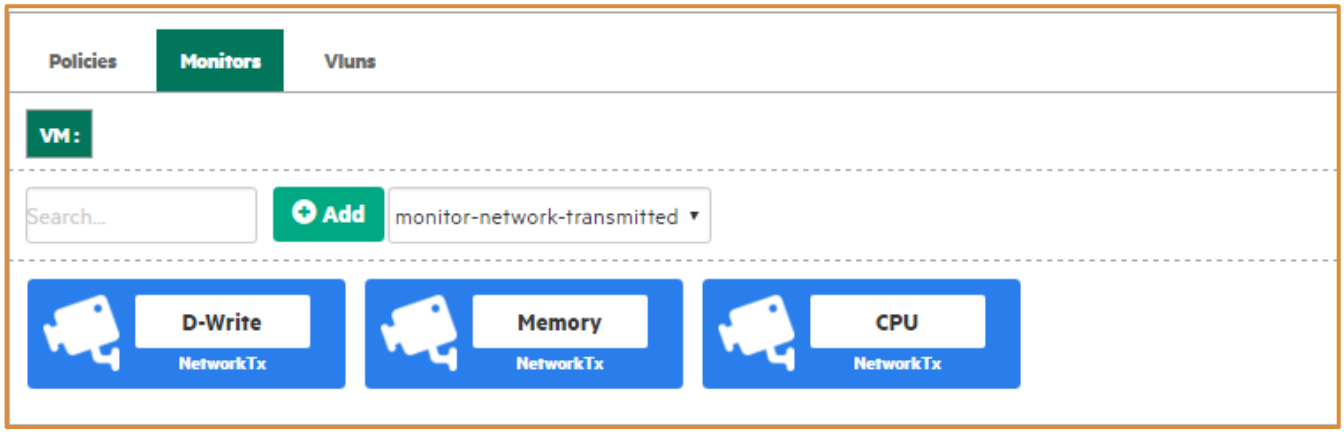


Figure 291: Multiple monitors assigned to a Component.

In the image above, we can see a Virtual Machine named `VM:Example VM`, with four different Monitors configured.

When some component is monitored, the symbol  appears over the component.

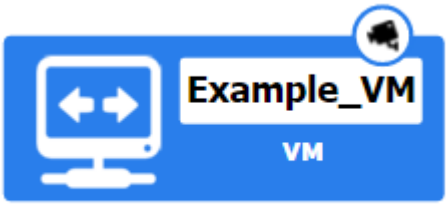


Figure 292: A monitored component

3.1.5.2 Configuring error Actions for Monitors

Monitors need to be configured to start their activity in case some attribute of the monitored element reaches a certain state, or some of its attributes exceed a quantity or surpass a number of communications. To achieve this behavior, the monitor has a `Condition` and an `Action` attribute that need to be filled. Unlike the general attributes of the monitor, `Condition:ErrorCondition` and `Action:ErrorConditionAction` work together as a trigger. When the condition is met, the action will take place.

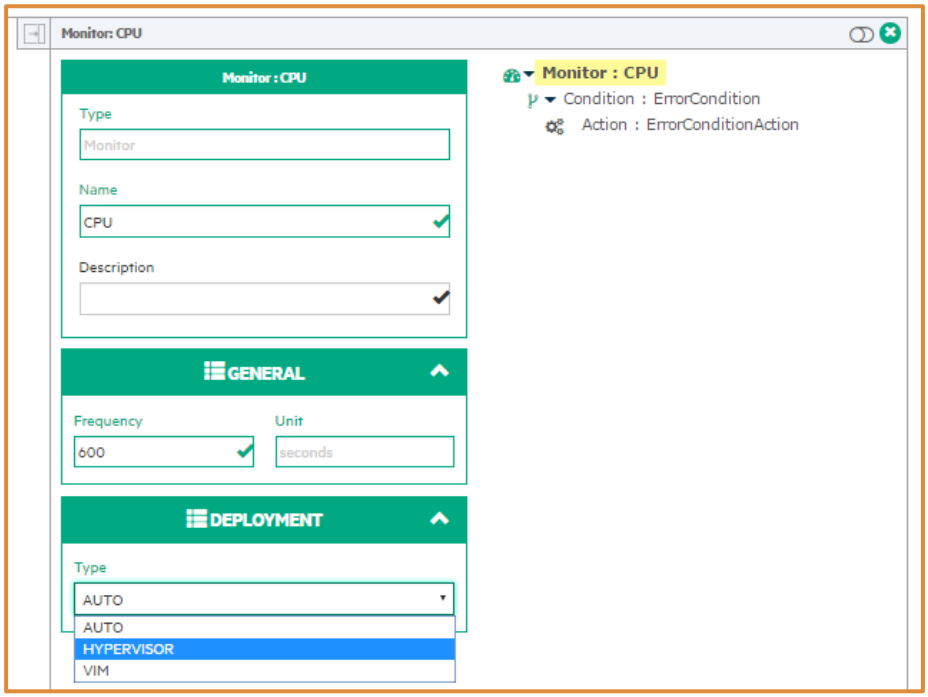


Figure 293: Configuring the error Condition and Action of a Monitor

As you can see in the image above, the monitor has the typical attributes `Name` and `Description`, and the attribute `Type` is not editable, as usual. To change the value of the previous fields, click in the field's box and introduce a valid name and description for the monitor.

The `GENERAL.Frequency` attribute refers to time gap between each capture by the monitor. It is set in milliseconds. In this case, the value automatically set is `600`. To change the value of the attribute, proceed as explained in the previous chapter.

The `DEPLOYMENT.Type` attribute refers to the element that is going to be monitored. In the image, the artifact selected is the `Hypervisor`. You can see the other two possible options. If the user selects `VIM`, the monitor will target this element for monitoring. If the user selects `AUTO`, the system will decide which element is going to be monitored.

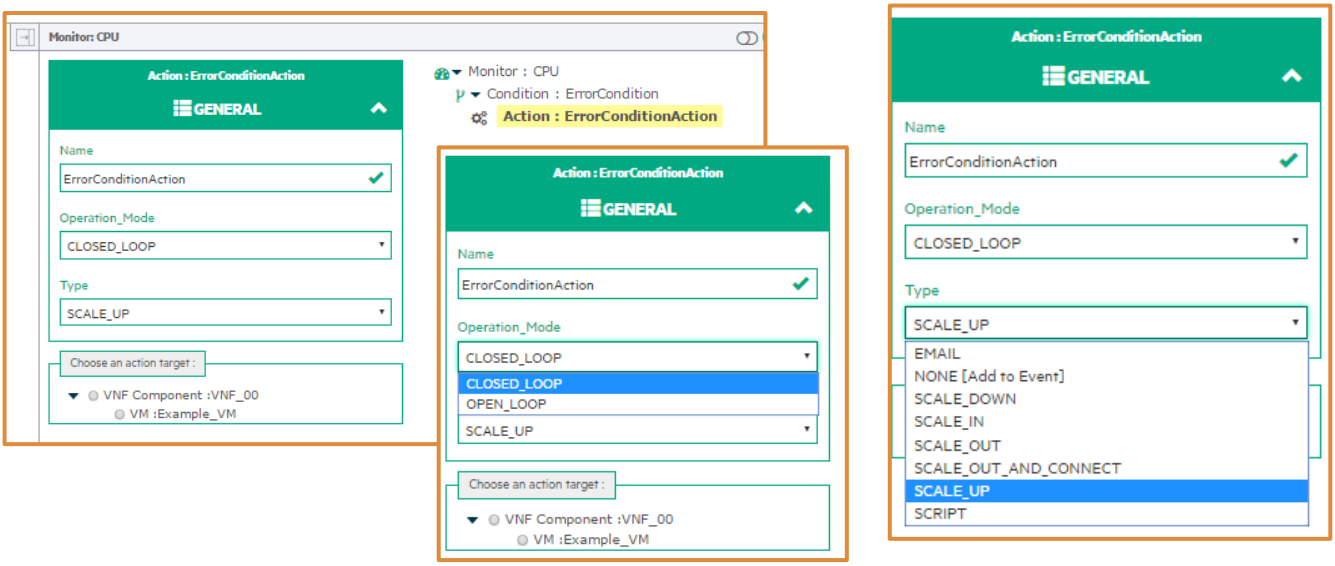


Figure 294: Editing the attributes of an error Condition Action for a Monitor

In the image above, we can see the different attributes of the `Action:ErrorConditionAction`. As always, we can see the field `Name` filled with the value `ErrorConditionAction`. After the `Name`, two attributes are present: `GENERAL.Operation_Mode` and `GENERAL.Type`.

`GENERAL.Operation_Mode,` can only take two values, `CLOSED_LOOP` and `OPEN_LOOP`. This means that if the value chosen was `CLOSED_LOOP`, the action to take is not going to wait for the user's operations to end. For example, if the monitor is configured to launch a `SCALE_IN`, the monitor will launch the scaling process without respect the running processes of the user. If the user chooses `OPEN_LOOP`, the monitor will wait to launch the Action until the user's operations are finished.

The "`GENERAL.Type` it refers to the type of the operation that the monitor it is going to throw if the condition is met. We should take into consideration that the user can configure a monitor that will never be used. For example, the user creates a monitor that has – as target – a Virtual Machine with a `SCALE_OUT` value in the field `GENERAL.Type`, It implies that the Virtual Machine is the owner of an Entity Scale (which is an error, as a Virtual Machine has no child suitable to be the child of the Entity Scale policy associated to the VM. So, the Scale Out has no element to be escalated, there is no child for the Entity Scale policy), and it also implies that that this policy has an element acting as child that can be the target of the policy. This is a condition that can never take place. The `Scale_Out` operations are launched at least over a VNF component level. This way we always have a child element to be escalated.

As you can see, a monitor can be used over a wide number of operations, mainly scale operations. These operations were explained in the chapter *Adding Scale Policies*. The operations that were not explained in a previous section are:

- SCRIPT:
  Refers to the case when, for a specific Condition, the monitor must launch a Script and not start an operation.

- NONE [add to Event]:
  Refers to situations when CPU use breaches threshold or the disk is about to run out of space. In such cases, an alarm will be raised, then we will handle this alarm and will perform associated ACTIONs like `SCALE UP/DOWN/SCRIPT`.

- EMAIL:
  Refers to the case when the occurrence of an event must be notified to an entity or subject.

In the section **Choose an action target**, the designer allows us to choose which element is going to be monitored. In this case, the user can choose from three elements, the VNF that it is being designed, the VNF Component that is part of the VNF, and the Virtual Machine that is member of this VNF component. Note that if during the design we have more than one VNF components, or these components has more than one Virtual Machines, they will be listed in this section.

3.1.5.3 Configuring Error Conditions for Monitors

The monitors need to have configured a condition that will act as trigger for the action of the monitor. Such conditions are configured by an expression that includes some attributes, referenced by their exact name and the value of the attribute referenced. Also, it should reflect how the condition is going to treat the changes in the attribute, for example, when the attribute's value becomes greater than the value reflected in the monitor.

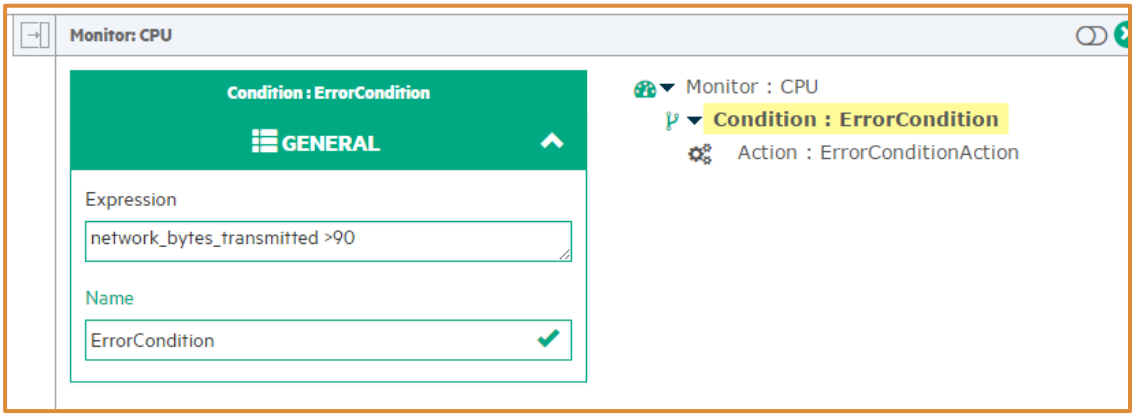


Figure 295: Configuring Error Condition for a Monitor

For the condition present in the Monitor Net-Rc, (image above) the attribute `GENERAL.Name` has a value of `ErrorCondition` and the `GENERAL.Expression` attribute has a value of `network_bytes_transmitted >90`, so, when the monitored element reaches 90 bytes transmitted through the network, the monitor will launch the operation present in the Action (in this case a `SCALE_UP`, see previous subchapter) `GENERAL.Type`.

To modify the value of the attributes, click in the box of the attribute and type a valid new value.

3.1.6 Adding VLuns to the component

A VLun is a storage component. A LUN is a unique identifier for a physical storage allocation. A LUN could reference an entire RAID set, a single hard disk or partition, or multiple disks or partitions. The VLUN does not map to a specific device or allocation of storage space but to a virtualized space that can be created in excess of the actual physical space available.

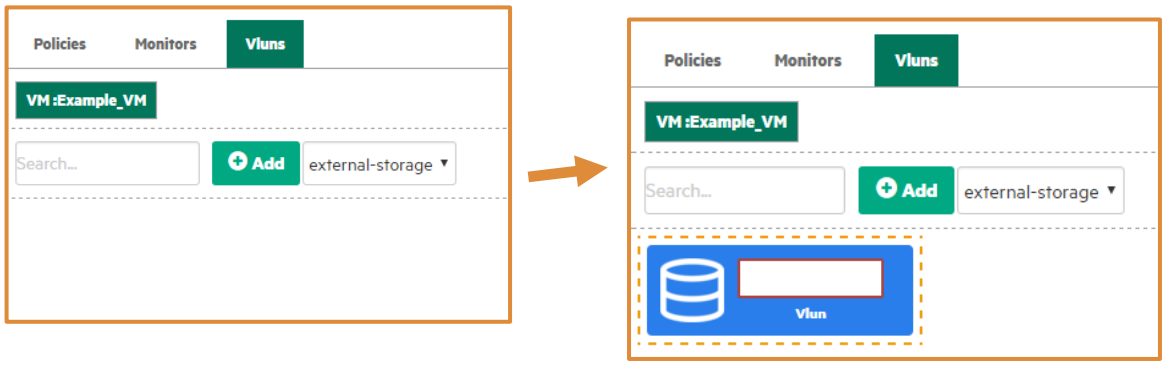


Figure 296: Adding VLuns to a component

To create a VLun from the web page, we need to position the cursor in the bottom left region the Component Designer, once there, click in the tag Vluns in the menu. The only option to choose for the type is `external-storage`. As explained already, to finally create the VLun, click Add. The VLun will be created under the influence of the VM :Example_VM.

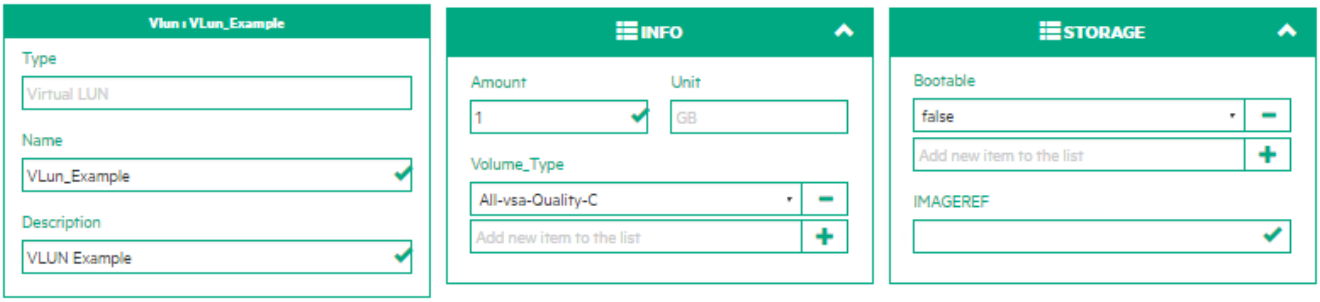


Figure 297: Attributes of a VLun

In this example, we have filled the `Name` and the `Description` attributes with the values `VLun_Example` and `VLUN Example`, respectively. To change the values of the attributes, click the attribute and edit the field.

In the `INFO` category, the user will set the size of the virtual storage in Gb. In this case, the size of the virtual storage is 1 Gb. The attribute `Volume_Type` allows the user to choose what kind of storage is going to be created for its use, the possible types of volumes are:

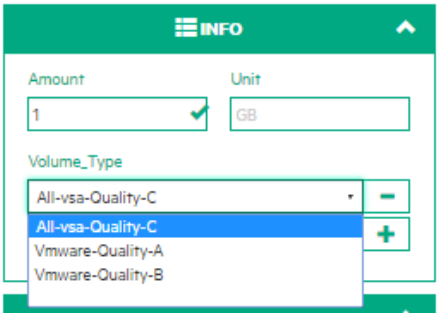


Figure 298: Type of Volumes for storage available

The types of VLUN have been configured on the OpenStack platform. From the solution, we are only able to choose the ones that were configured previously. In our case, `All-vsa-Quality-C` was selected.

The `STORAGE` category refers to the configuration of the virtual storage device. In this case, the `Bootable` attribute, allows or denies the possibility of booting from the volume. Notice that this volume could be part of a SAN (Storage Area Network). If this is the case, we will talk about booting from a SAN, not only from a LUN.

The `IMAGEREF` attribute refers to the file that will be used to create the VLUN. If we configured a bootable VLUN, it should be filled with the name of an image configured in the solution. This means that we need to use an image that is managed by the NFV Director. So, we will use one of the images that we have created for our VMs, the image that we will use with our VLUN must not necessarily be the one that we will use with our VMs. If the types and attributes have correct values, it will allow the user to create a bootable volume from the image specified.

Note that a component can have more than one elements from the list on the left side of the web page. This way, we have the possibility to create components with more than one Virtual Machines.

In the case of a Helion Carrier Grade environments, we must have at least one VLUN, with its attributes `STORAGE.Bootable` set as `true`, making the VLUN bootable, and its `INFO.Amount` set to a value of `0`. A HCG environment will develop an internal conflict otherwise. We need to have storage configured to get the expected behavior. The machines deployed in a HCG environment without VLUNs configured will not behave as expected.

When a component has a VLun added, the symbol  is shown above the element in the workspace.

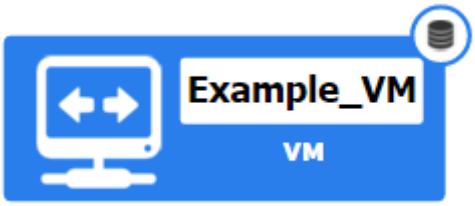


Figure 299: A component with storage configured

3.1.7 Deleting elements in the designer

There are various ways to delete a component in the designer. The user should not misunderstand the concept of delete and cancel in the designer. If the user's intention is to eliminate one component of the design, the user will erase unitarily the component selected. If the user's intention is to dismiss the design of the main component, the user will use the option Cancel of the top menu of the designer to delete all the design with all the components inside.

The first way to delete a component is by using the button present at the end of the top of the attributes menu:

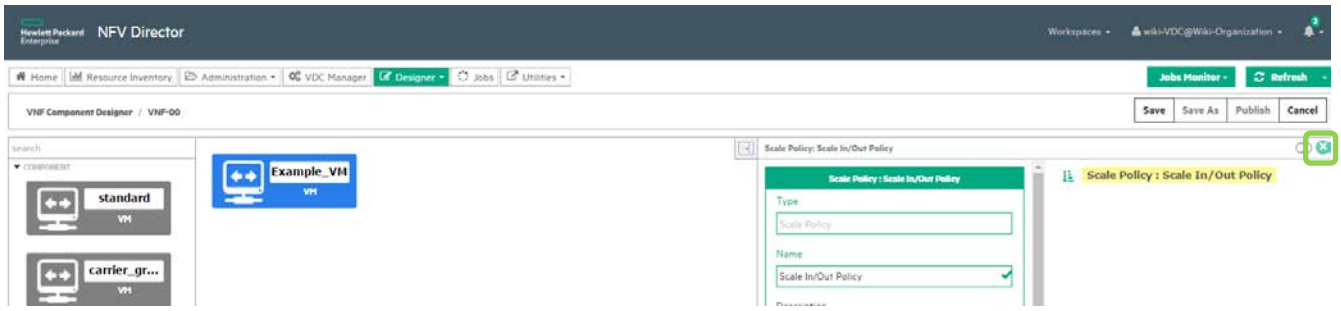


Figure 300: One way to delete elements from the Component Designer

This icon is only available if the user has selected a component in the workspace. It would be highly unproductive if the users were able to erase the component they are working on before it has been created.

To finally perform the deletion, click The following window will be displayed:

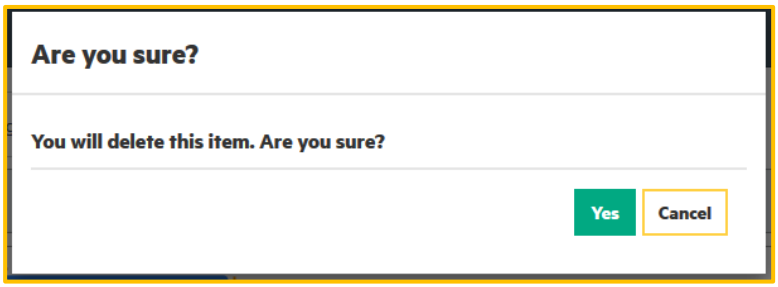


Figure 301: Confirmation window for deleting a component

To delete the component, click Yes. The component element selected will be deleted, and no message or jobs are generated by this action.

3.1.8 The list of the component's elements

As we said before, the list of elements of the component permits the user to change the attributes of the element selected. In the images below, the user has selected different elements/artifacts. These artifacts have their own attributes, but they have common categories. This implies that some elements need to be fulfilled or configured before saving the component.

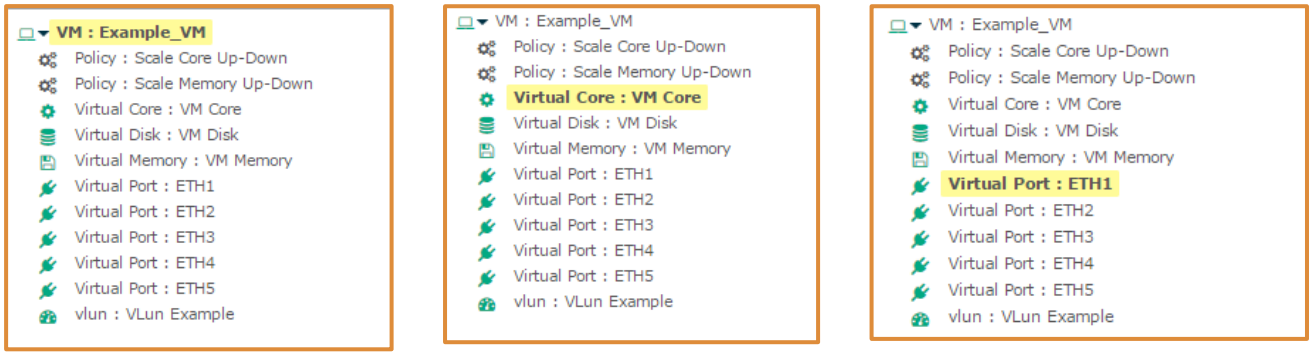


Figure 302: Elements that conform different components of some entities

When explaining how to create policies of various types, we discussed how to change the values of the attributes of these elements. Below these lines are the attributes that are shown suitable to be edited after selecting the artifact in the list.

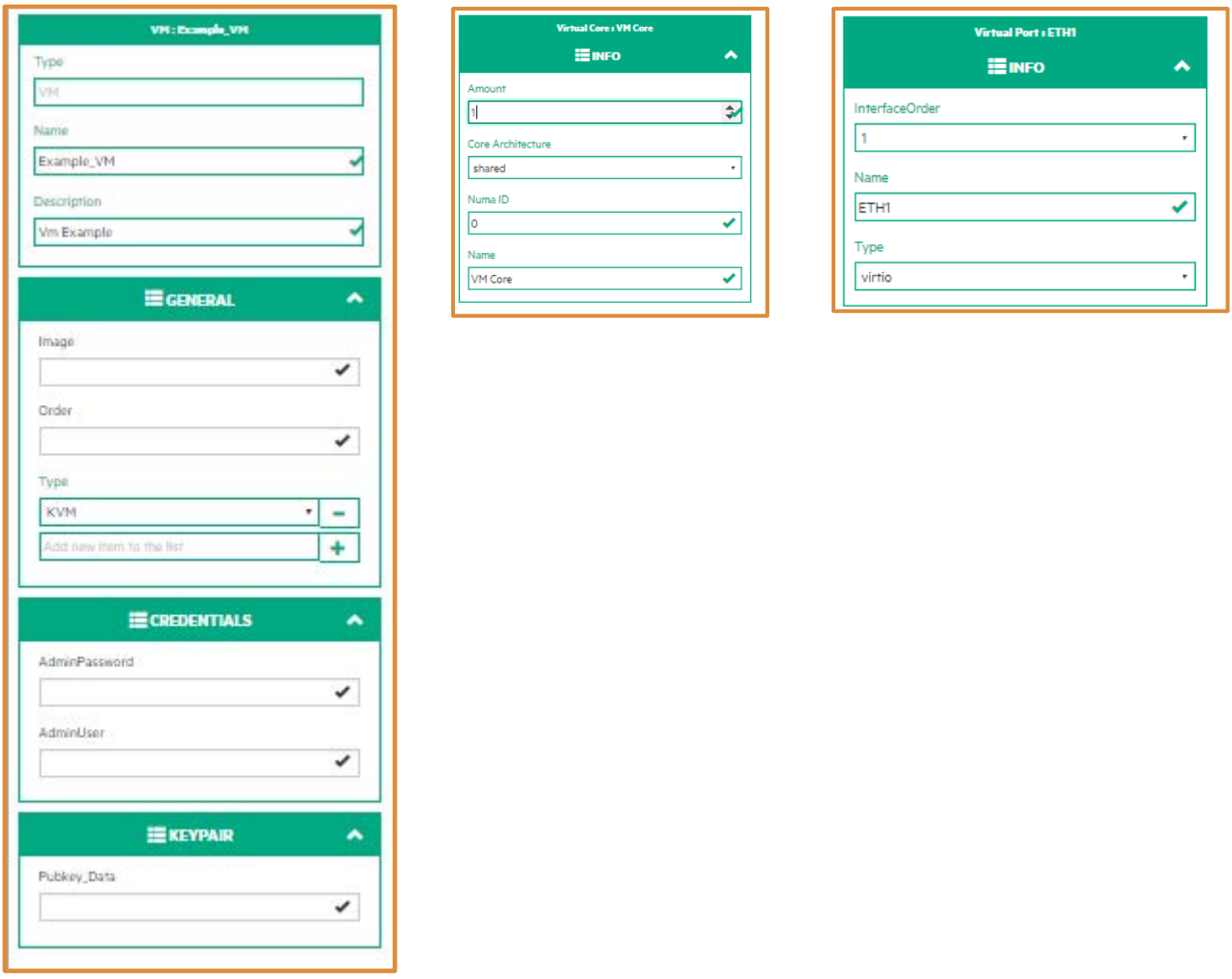


Figure 303: Different categories of the components

If you run into any problems filling some attributes during the creation of the component, or if the component is not accessible from this list, it is not necessary to edit the component.

3.1.9 Publishing your component

Once we have finished designing our new component, in order to make it usable, we must save it before we can include it in a VNF.

First, we should properly fill the `Name` attribute of our future component. To do this we should select our work space that represents the VNF component that is being configured.

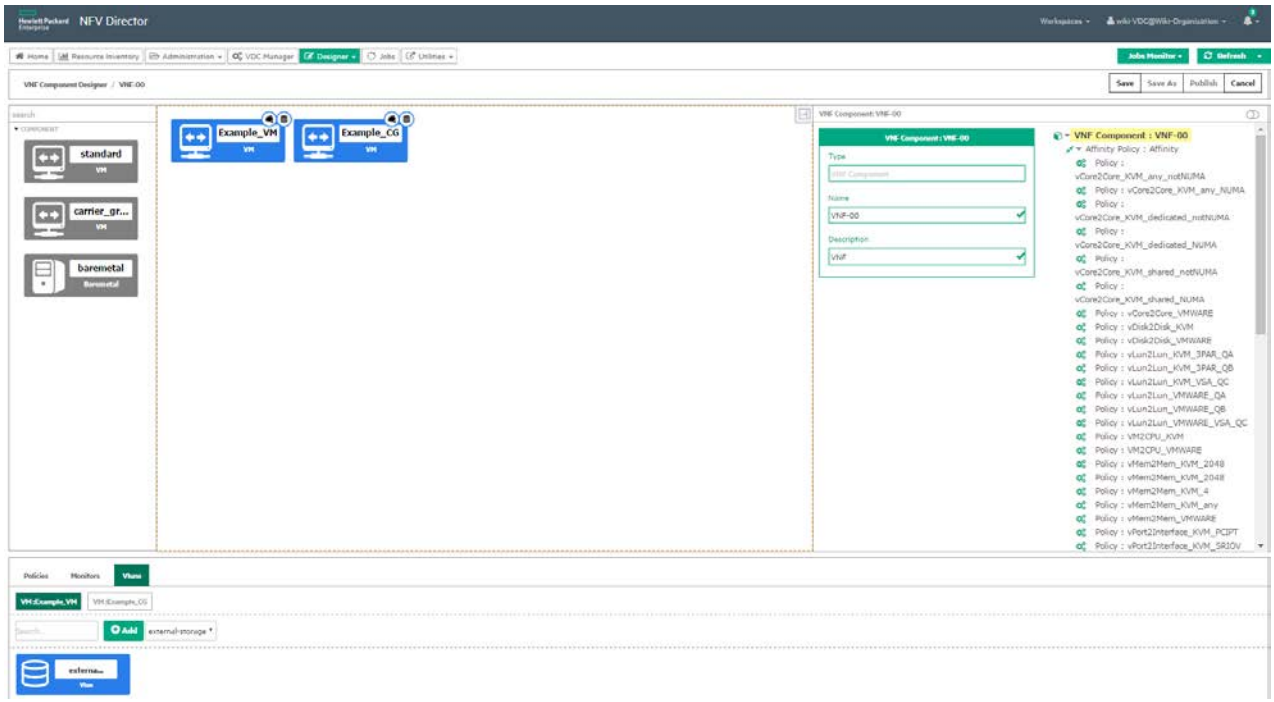


Figure 304: Publishing your components

As we can see in the image above, the user gave as value for the attribute “Name”, “VNF_00”, this name is what will be shown in the “VNF Designer” when the user look for the component to be used, If we have completely finished fulfilling the different attributes for our specific purpose in each element, and we are pretty sure that we have all the elements needed correctly configured we will proceed to save the component.

To save the component, click Save at the top-right side of the web UI. The application is going to create the user’s component. After saving it, the component must be published to become eligible to be part of a “VNF Designer”. The component is published by clicking Publish in the previously mentioned menu.

If the publishing was successful, when the user opens the “VNF Designer” and selects the VNF_Base element, the component that has been published will be available as an element to be included in the design of the “VNF”.

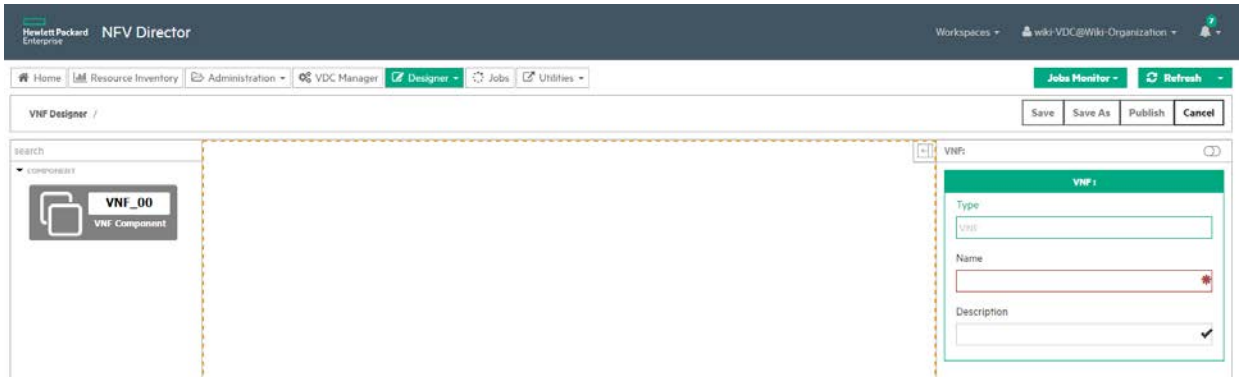


Figure 305: Component designed available to be used

3.1.10 Making the designed components visible

To make our VNF components visible for the VDC Manager, we should assign them to a VNF Group. Otherwise, it would be impossible for the VDC Manager to use these components.

To make these elements visible, the user must go to the Management section of the web platform's top menu, and select the section VNF Registration & Management. Once there, we need to select our group and click Action. Then the user will see a list like in the image below.

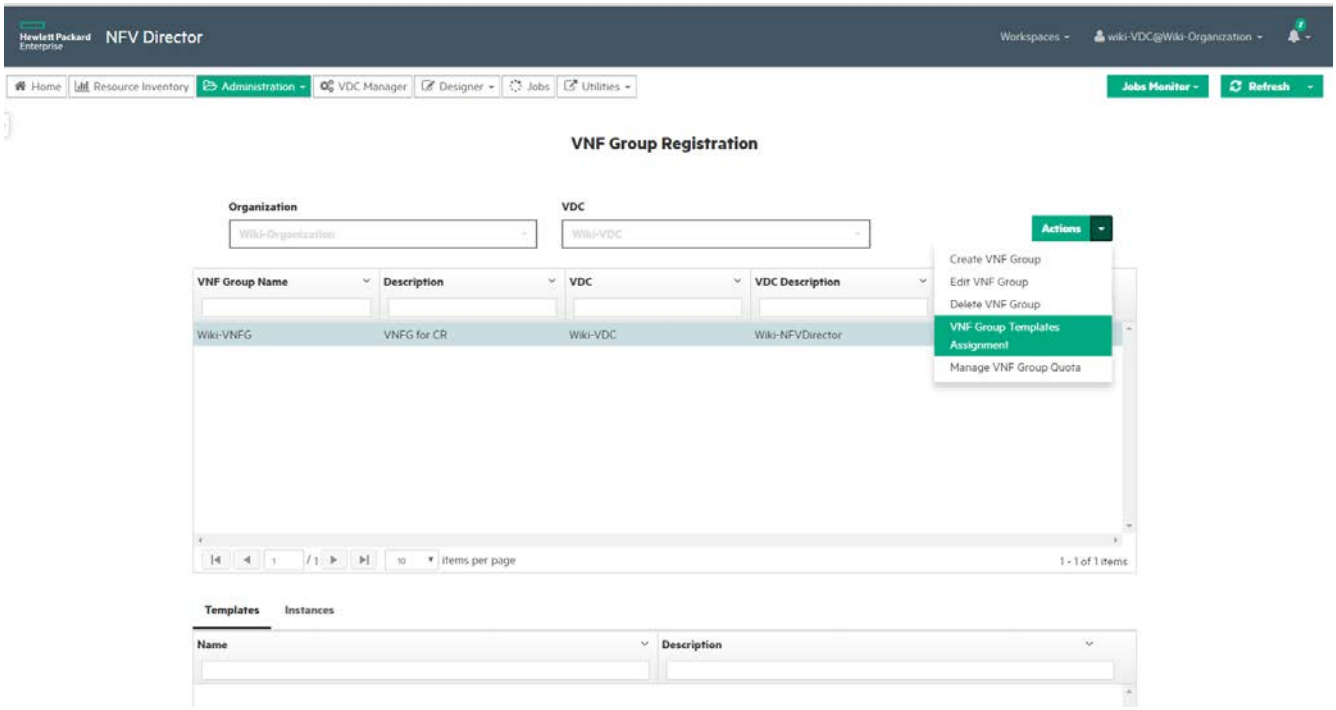


Figure 306: Make visible the components designed for the rest of users

In the list, the user must select VNF Group Template Assignment by clicking the element. Once selected, the user will see the following window:

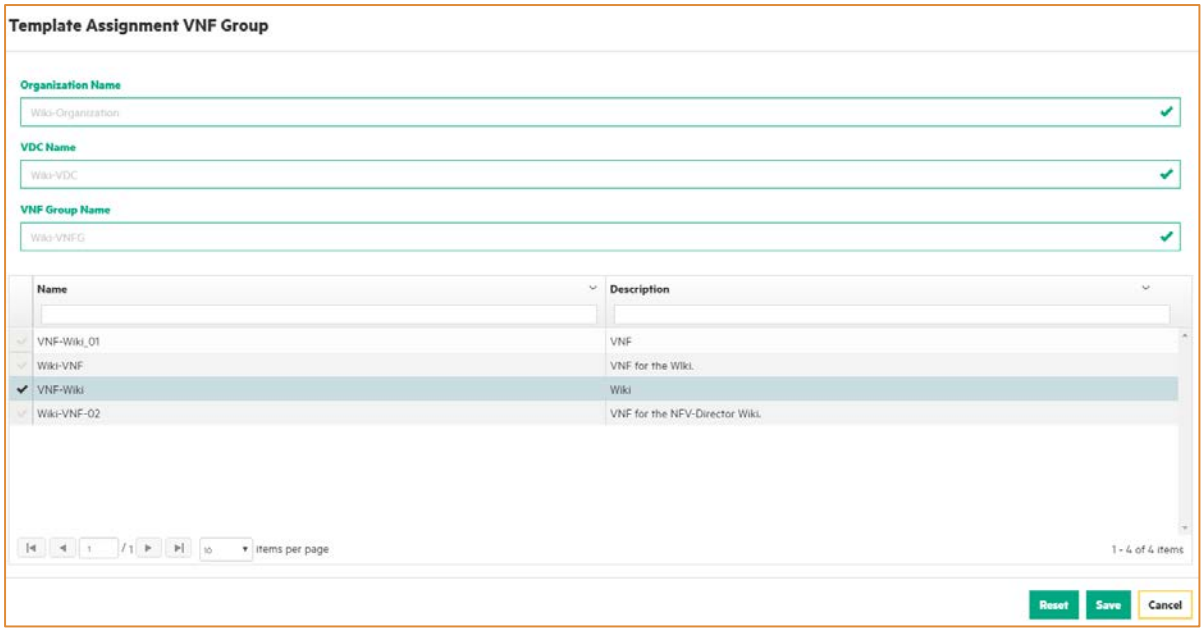


Figure 307: Assigning the elements to the adequate VNF Group

In the lower half of this window, the user can see the name of the VNF components and VNFs designed with the "VNF Designer" or with the "VNF Component Designer". To make such elements usable by the VDC Manager, select the two of them. If the user has more elements of the two types in the list, tick or untick the box at the left of the name of the components to select or unselect them.

After selecting the items, to make the changes effective, the user should click Save at the right bottom corner.

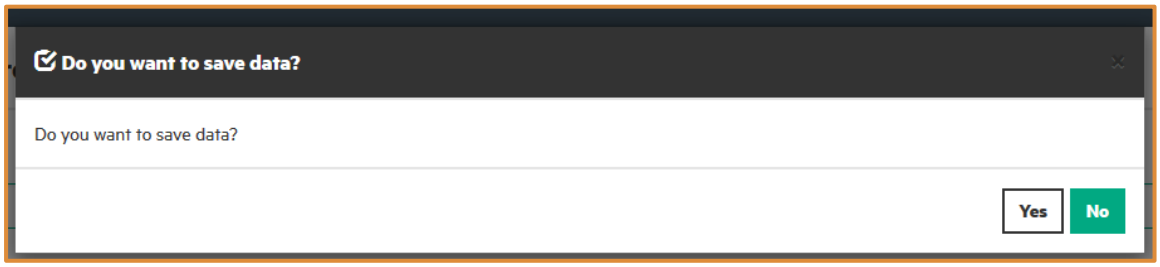


Figure 308: Confirmation window for the assigning of components

If the assigning was successful, the user will see the below message:

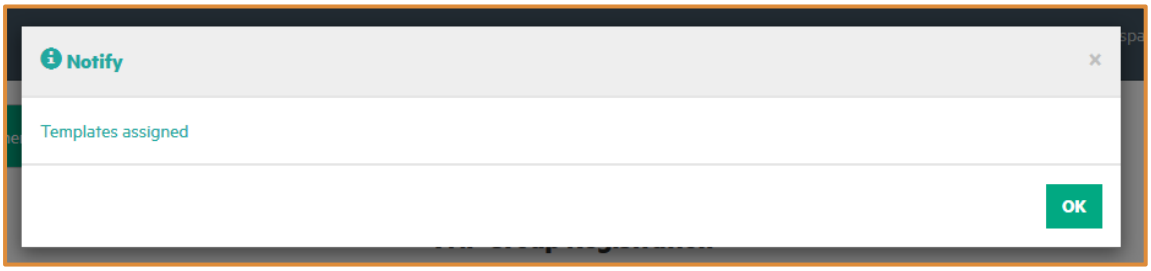


Figure 309: Confirmation message of the assignation.

The VNFs should be always associated with at least one VNF Group. If the user being used is of VDC level, it is recommended associate all the VNFs.

3.2 VNF Designer

3.2.1 Introduction

The VNF Designer is an online designer implemented in our NFV Director platform. It allows us to design and modify the attributes and specifications of the VNFs that we are going to use later. To access to the designer, go to the top menu of the NFV Director Web. The third element in the menu is **Designer**. Right-click on the menu element to obtain a list with two elements. Select the one named **VNF Designer**. Note that the user only has access to this designer with the right user level. The most recommended level is "VDC".

3.2.2 Screens of the designer

3.2.2.1 First Screen of the Designer

After selecting **Designer** in the top menu, you are going to see a screen like the below:

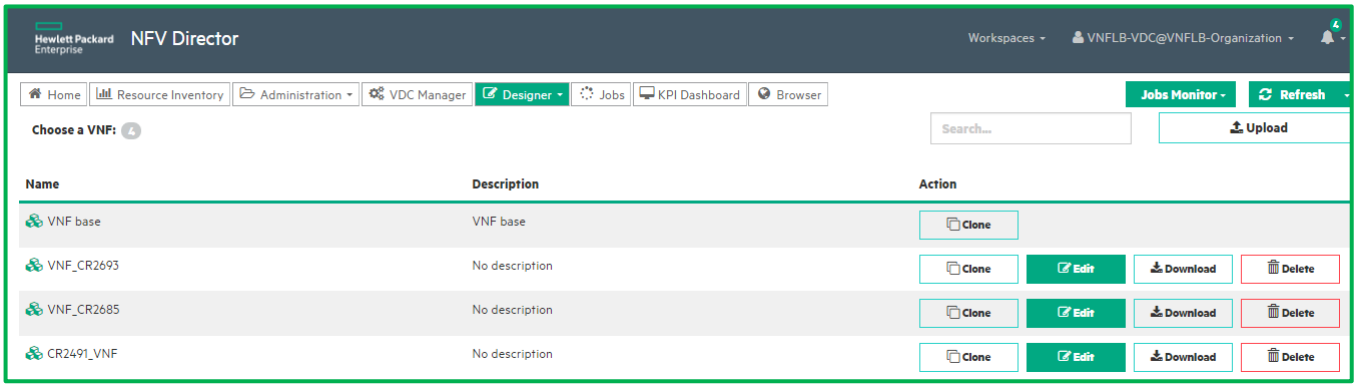
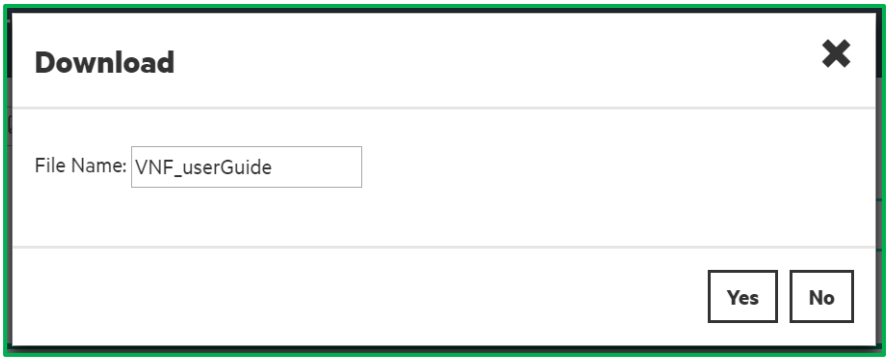


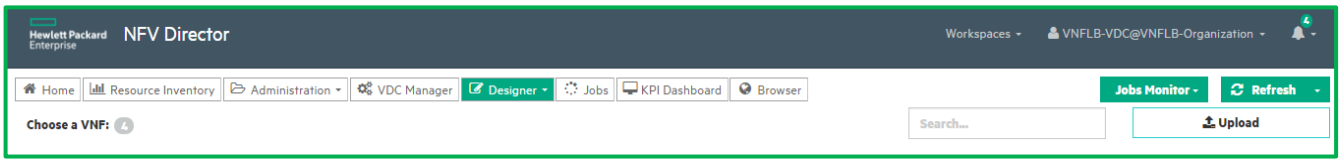
Figure 310: First window of the designer

The **Download** button allows us to get the file of the component that we choose. The design will be exported to an xml file. To download the design, click **Download** next to the component selected. A new window will appear, giving us the option to choose between the two file types. It will also allow us to change the name of the design.

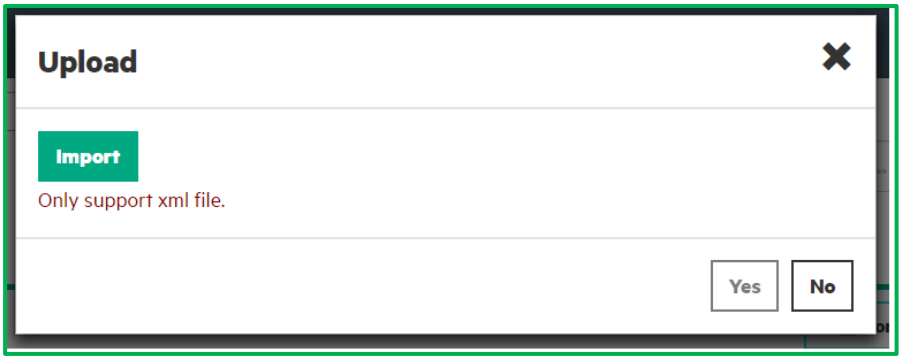


To execute the download, click **Yes**. In the case of the image above, after clicking **Yes**, an xml file will be downloaded with the name `VNFC_UserGuide.xml`.

There is another feature implemented in this version, the "Upload" and search of the entities for our designer:



In this version, we can upload an already designed and functional VNF that we have stored locally. To upload a new element to be edited with the designer, click **Upload** and a new window will appear:



The upload only accepts XML files. After clicking **Import**, a new file explorer window will appear. Choose the file to upload. After selecting it, click **OK** in the file explorer window. Click **Yes** in the upload window. When the upload is done, the new element will be listed in the "VNF Designer" list of VNFs available.

Next we need a template for our future components. To have a standardized starting point for all the future components, the first thing to do is cloning the "VNF base". This element has the logical structure needed to build above our VNF. To execute the cloning, click **Clone** on the right side of the page.

After clicking **Clone**, the next page that is going to appear is the designer with all its sections.

In this screen, we will see (at least) the components that we created, saved and published in the "VNF Component Designer". In this case, the user will see (at least) the component `VNF_00`, previously created in Chapter 3.

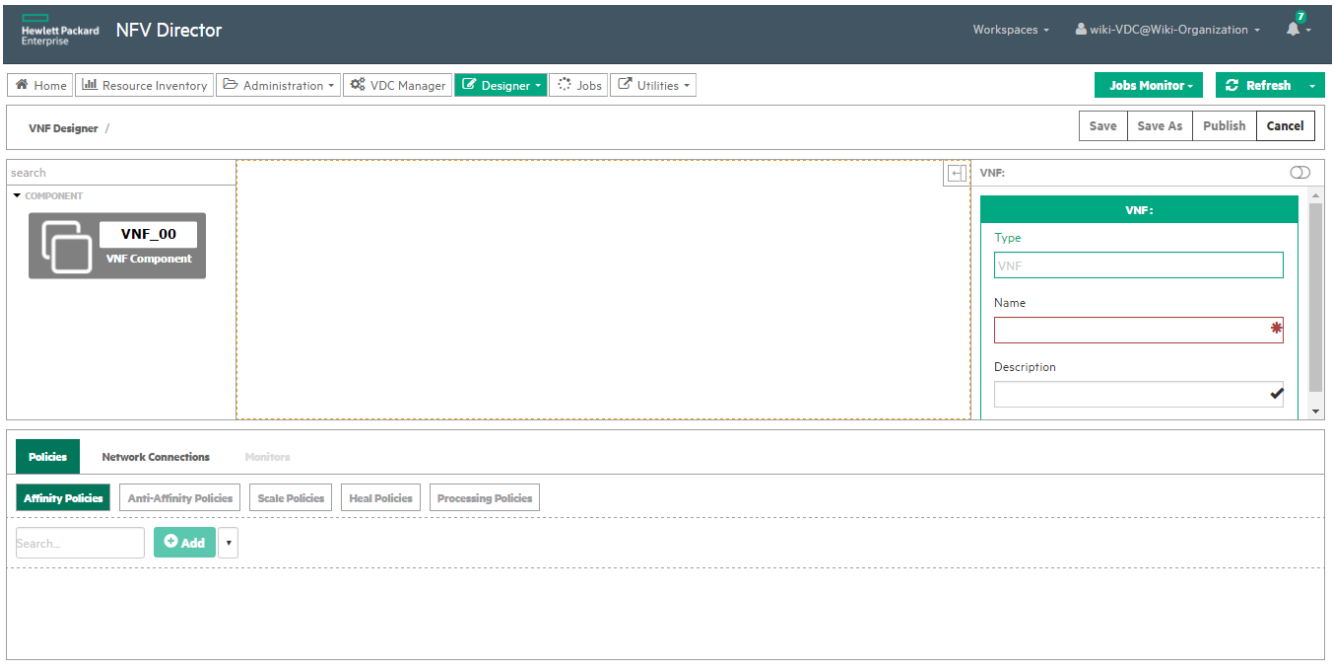


Figure 311: Inside the VNF Designer

3.2.2.2 Main Screen of the Designer

The main screen of the Component Designer has five main zones. We are going to explain the different parts from the top to the bottom of the page.

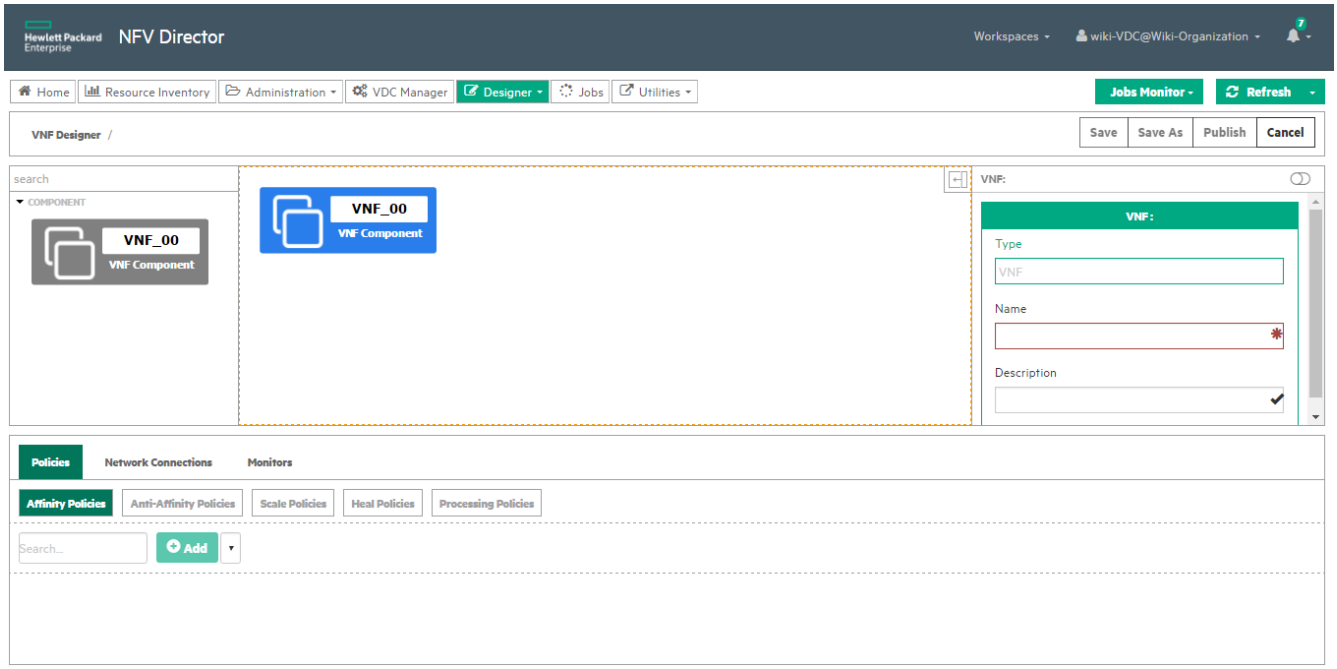


Figure 312: Creating a VNF Component for the VNF

Just under the top Menu of the NFV Director Web, we can see the beginning of the Component Designer. The first element on the top includes the name of the tool in use on the left, in this case, VNF Designer". This element contains usual options to save/cancel/publish our design on the right. The **Publish** option refers to the action of making the designed component usable for the creation of a VNF element. To publish an element, save it in advance.

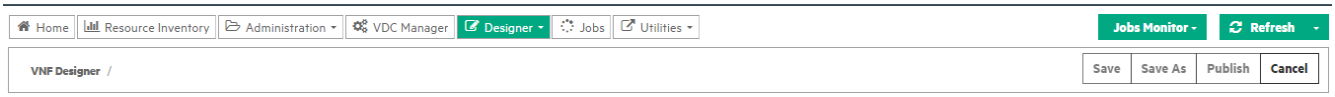


Figure 313: Top Menu of the VNF Designer.

The center part of the page harbors three of the five parts of the Designer, it will be described from the top to the bottom.

Using the Component list and the Search tool on the left side of the Component Designer, we can search for other components that are listed. In this case, we only have one possible component listed, a VNF Component named `VNF_00`. To know more about creating components for our VNFs, go to section 3.1. If our NFV Director platform detects more components suitable to be used as elements in a VNF, they are listed in this section.

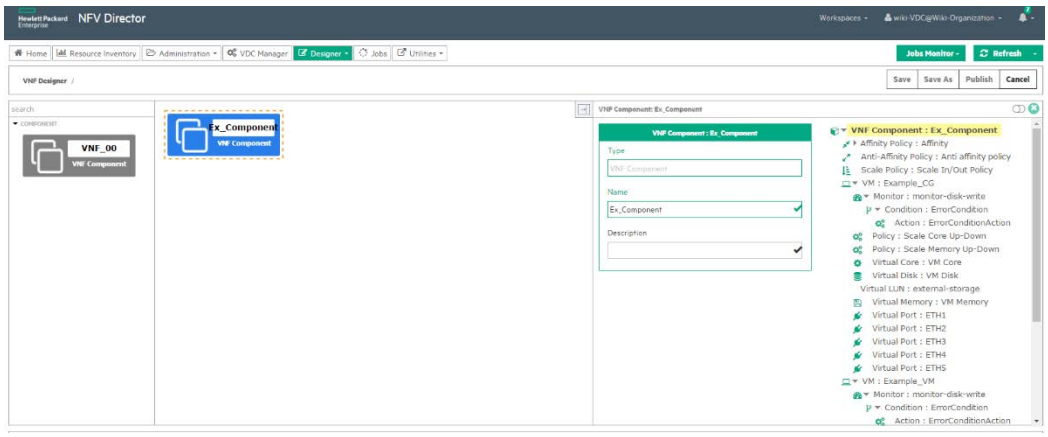


Figure 314: The central part of the Designer

The middle of the web page is the work place of the designer. If we select a component of the list and drag it to the center of the web page, the component will be created and will appear in this space. This way, it is possible to edit and customize the component. When all the elements are created, and we want to see all the components listed, it will be enough to select the work space to see the list on the right side of the designer. To select work space, click in an empty zone of the work space.

The fourth part of the Component Designer is located on the right side of the web page. This is where we can edit our components, by changing the different values of the attributes in each category. Some of these attributes are not editable (such as the `Type` of some components, or some critical attributes), because they were set at the creation of the component to make sure that the value of the field is adequate, and to avoid future problems. Another possibility is that the values will be editable in another phase of the component. Notice the element in the top right corner of the field:  This button permits to edit and consult all the elements of the component that have been created, or the component that is just about to be created.

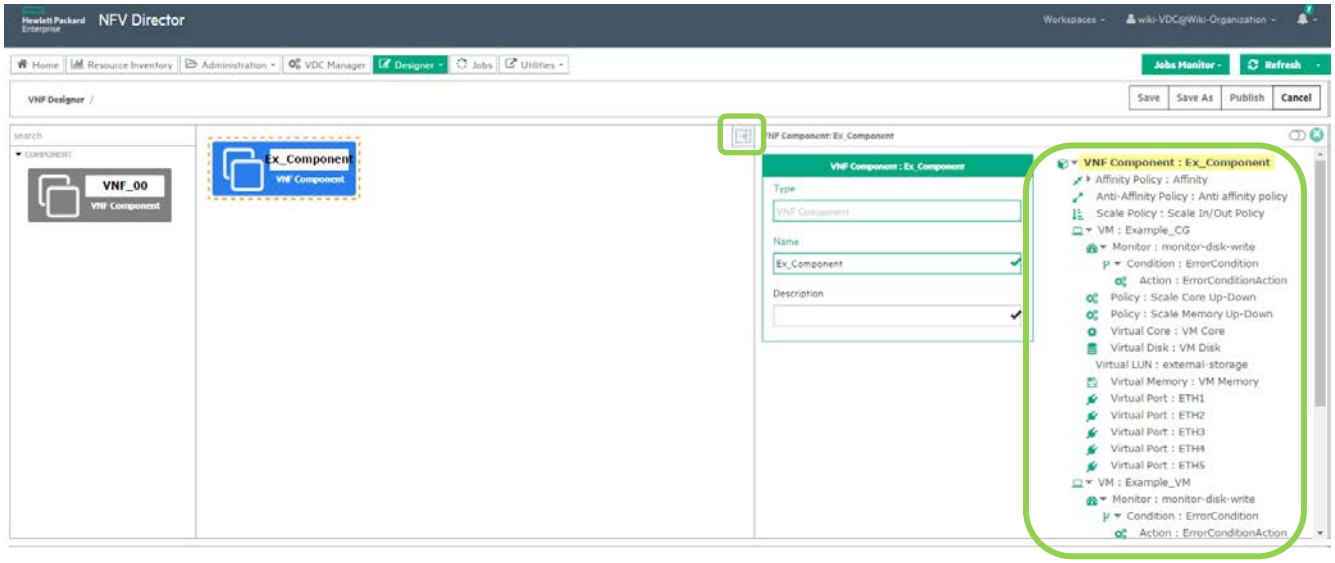


Figure 315: The attribute's window in the VNF Designer

The fifth part allow us to add and modify policies, network connections and monitors.

Figure 316: Bottom Menu of the VNF Designer

3.2.3 Creation of elements for the VNF.

To create new components for our VNF, open the designer and select the component to create from the second part of the designer (as explained before). In this part, we have the list of possible components suitable to become a part of our VNF.

For example, to create a `VNF_00` component, select the component on the left side of the NFV Director web UI "VNF Designer" and drag the future component to the work space in the center of the web page. It results in the following:

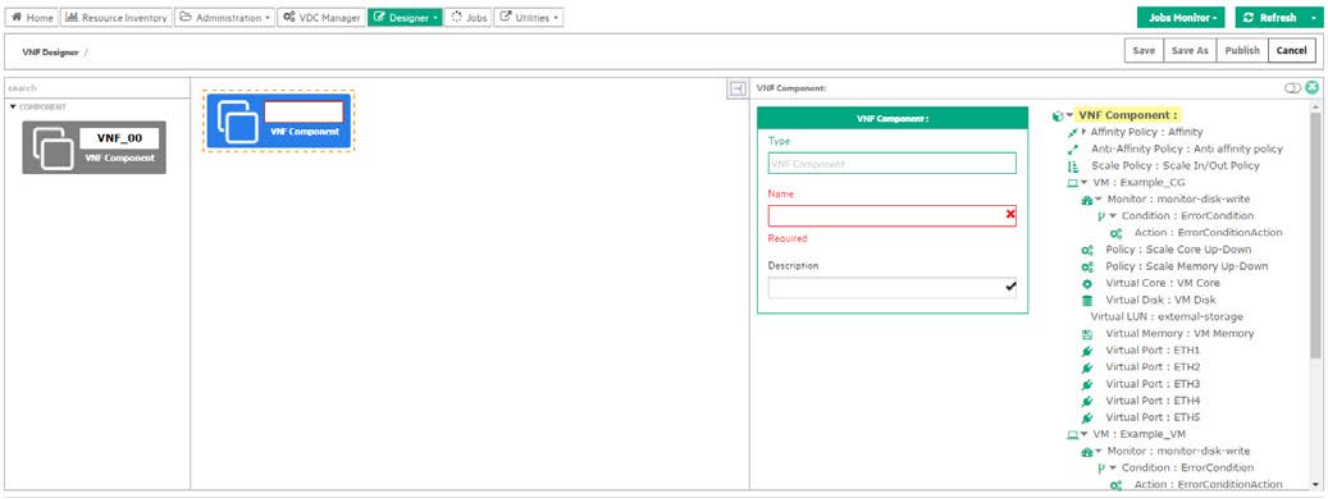


Figure 317: Creating a new VNF Component for the VNF

Notice that the active elements in the work space are colored in blue. Also, notice that in the fifth part of the Designer, in the bottom of the page, we can see two news sections, Network Connections and Monitors. Network Connections is responsible for the creation the End-Point necessary to connect the different elements and entities related to the VNF designed by the user. Monitors refers to the creation of different types of associated monitors to monitor the behavior of the component.

Also, in the right side of the web page you can see a field colored in red. These fields are mandatory parameters that must be filled before the publishing of the component, otherwise, publishing will not be permitted. This time the field `Name` of the VNF is the one that must be filled to continue.

The list of attributes present on the right side of the web page is the list for the edition of each element in the list. This means that when we select an element from the list, it will be marked as active element, and it will be loaded in the attributes editor on the left. The field in red is displayed because the element selected in the list is the VNF itself.

If we scroll down in the attribute editor of the Designer, we will see the rest of the editable attributes of the selected element, in this case, a VNF. At least we should fill the `Name` attribute with a correct value to continue with the publishing of the element.

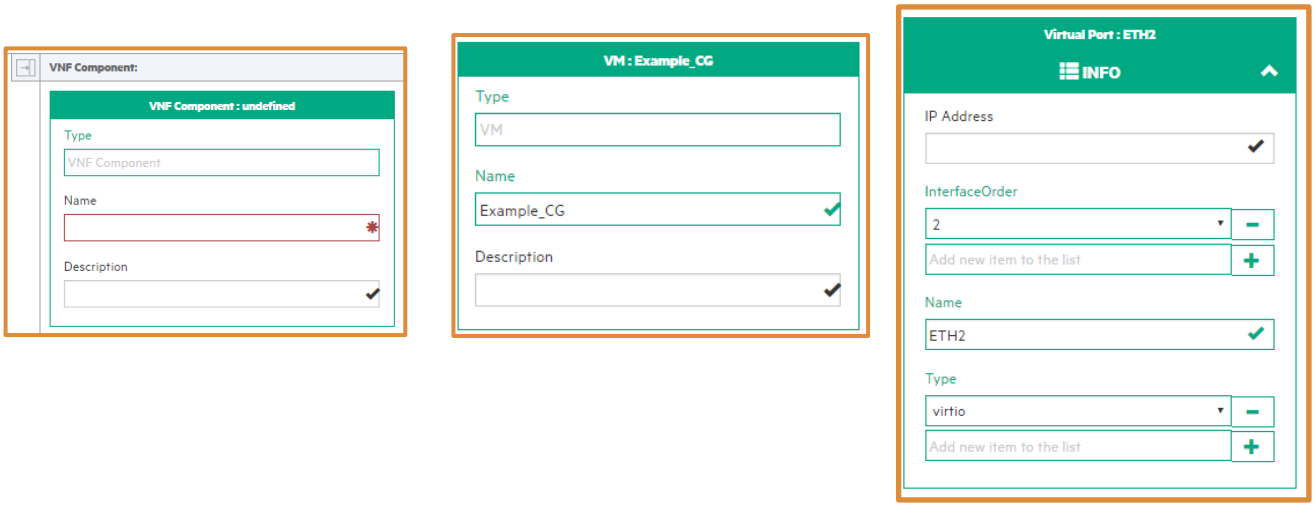


Figure 318: Categories of the VNF Component

3.2.3.1 Creating a VNF Component for a VNF

The creation of a VNF Component begins with the selection of the component in the list of possible elements in the second part of the Designer. This is the list present on the left side of the web page. As we explained before, this list contains the valid elements to be integrated in the future components.

This list is filled with all the possible elements suitable to be part of a new VNF. The creation of these elements takes place in the “VNF Component Designer”. The steps that the user should follow to create such of components is described in Chapter 3.

Once the user understands that these elements are not trivial, and are conformed of other elements previously configured with the help of another (very similar) designer, the user can continue with the designing of a new VNF.

After selecting the element, drag it to the work space and wait for its creation.

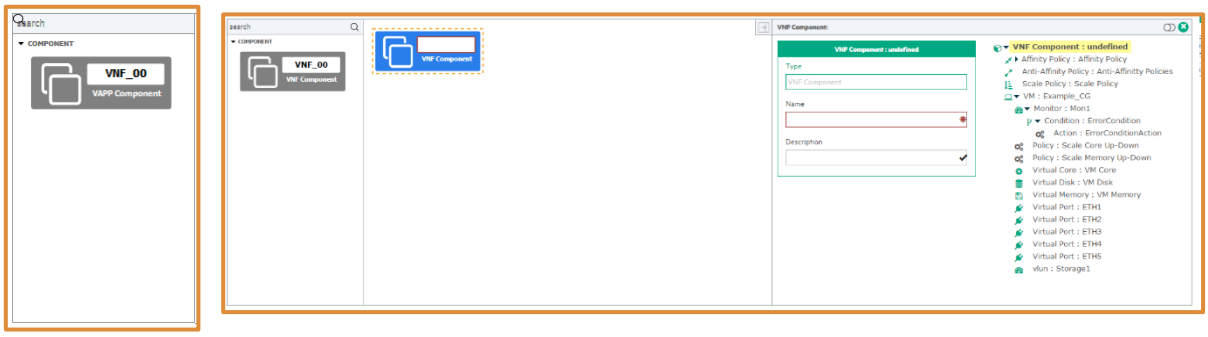


Figure 319: First step in the creation of a VNF

As you can see in the images above, we selected the element `VNF_00`, and we dragged it to the work space. The element has been created and is colored in blue. As you can see, all the attributes and internal elements of the component are in the list right of the designer. Also, see how the designer requires the `Name` field to be filled, as that is a mandatory field. It is filled with the value `VNF_Comp1`.

In the above image, on the right side of the designer, we can choose and change the values of some of the attributes present in the elements listed. Inside our `VNF_00`, we have policies, Virtual Ports, Virtual Core, Monitors, and so on. All these elements are editable within certain constraints. If you select one of these attributes, you will see how the component window changes, showing the attributes of the element selected.

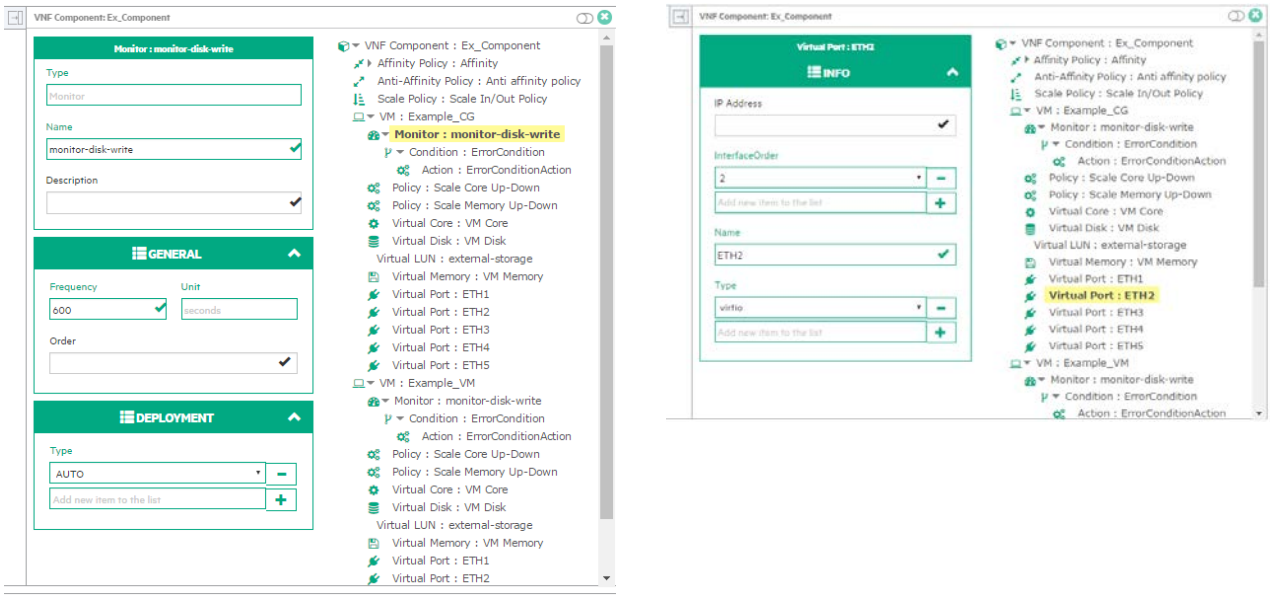


Figure 320: Elements that conform the VNF

As you can see, the window that allows us to edit the attributes will change with the element selected in the list. Once we carry out the creation and modifications required by the component, we will proceed to the assigning of policies, network connections and monitors. This part of the creation is common to all the elements, so it is going to be discussed in another section.

Once we have created the element, we can edit the attributes and the components of the element. We are going to introduce a new name for our Virtual Machine. To do that, select the element in the work space by clicking it, then click in the `Name` field on the right side of the work space. Type the new name for the VM, in this case, it is `VNF_Comp1`.

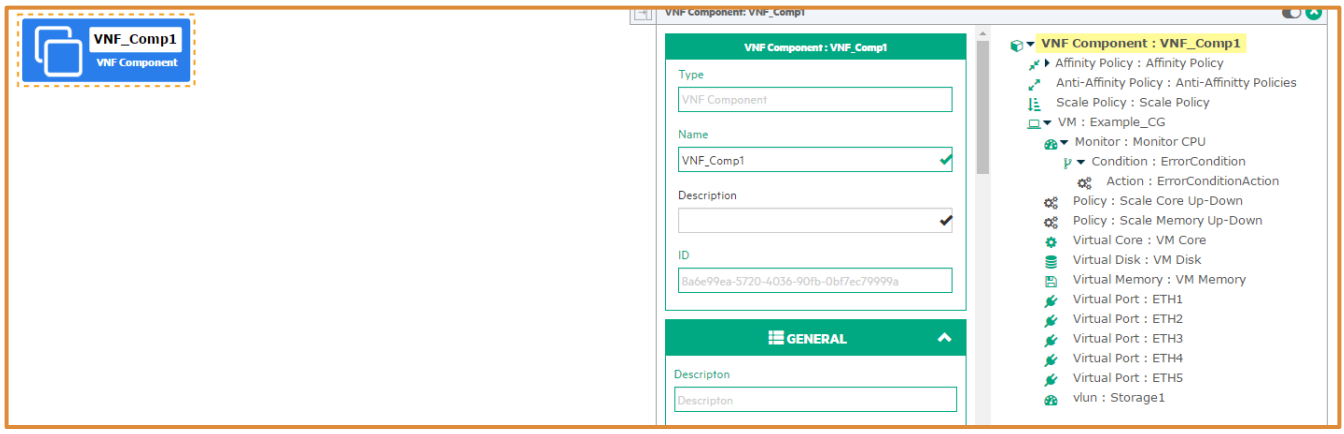


Figure 321: Editing the VNF's name.

To configure our Virtual Machine to behave correctly during the future execution, we need to fill all the attributes in all the categories until the green tick appears at right side of the box.

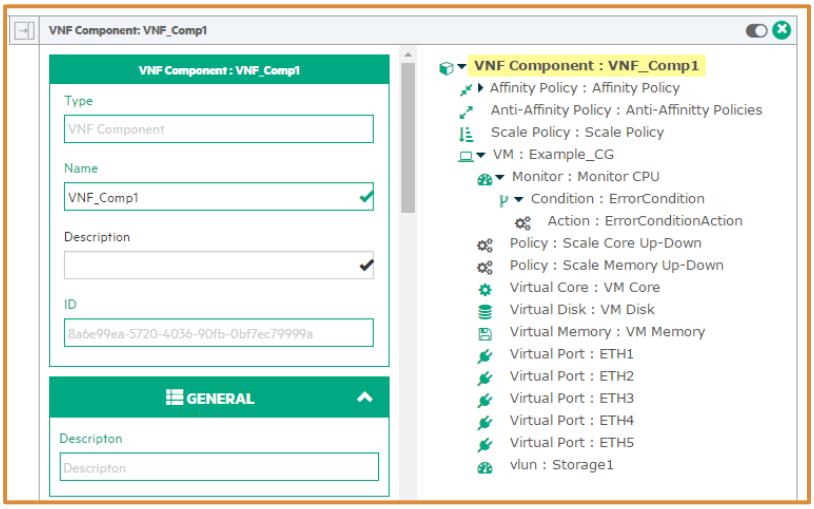


Figure 322: Editing the rest of the attributes of the VNF

In this example, we have filled the attributes `Name` and `Description` with the values `VNF_Comp1` and `Component 1`, respectively. The other editable attribute of the `VNF_Comp1` Component is the `GENERAL.Name`, which is an auto-generated value, in this case, `VNF Comp`. The user can edit this field at his will. Note that we can create two VNF Components from the same element. This means that it is possible to duplicate VNF components when we are creating a VNF with the designer. Keep in mind that we are referring now to the final VNF, the one that is going to be used as a whole, and the objects that can be duplicated are the components of this final VNF, not the elements that are parts of this VNF's components. Those can be duplicated if necessary, to meet the needs of the user. This is explained in Chapter 3.

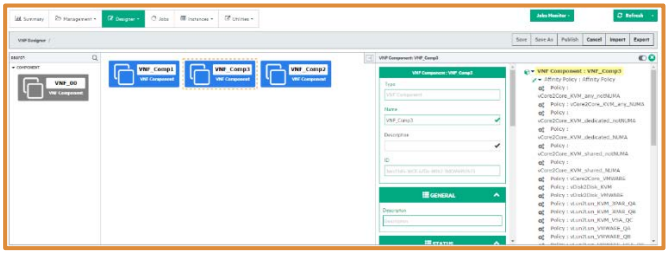


Figure 323: A VNF with more than one VNF Components

3.2.4 Adding policies to the component

We are going to discuss this in another section due to the peculiarities of this elements and the assigning process. If we need to create a policy to be attached or connected to an element, we should have the element properly created, with all its attributes correctly filled. Also, we must know clearly what policies our element needs. Once we know and have what is needed we can start the process of creation.

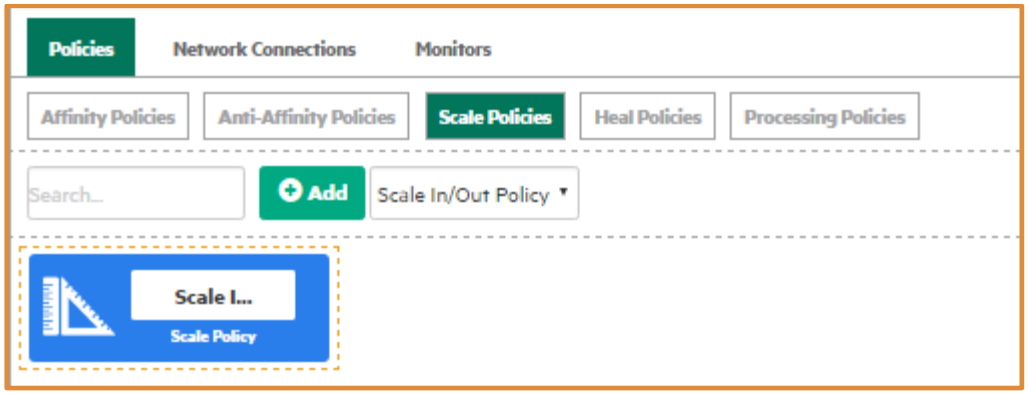


Figure 324: Adding Scale policies to the VNF

The designer allows us to create one type of policy over a VNF, a Scale policy. The rules to create this type of policy will be described in the following sections. The Affinity and Anti-Affinity policies are already included in the VNF. These policies can be edited, although they were created with the component.

3.2.4.1 Modifying Affinity Policies

An Affinity Policy allows us to indicate where and over what artifact the assigning of resources is going to take place. At this level, the Affinity policies are limited to the ones that were created in the components previously.

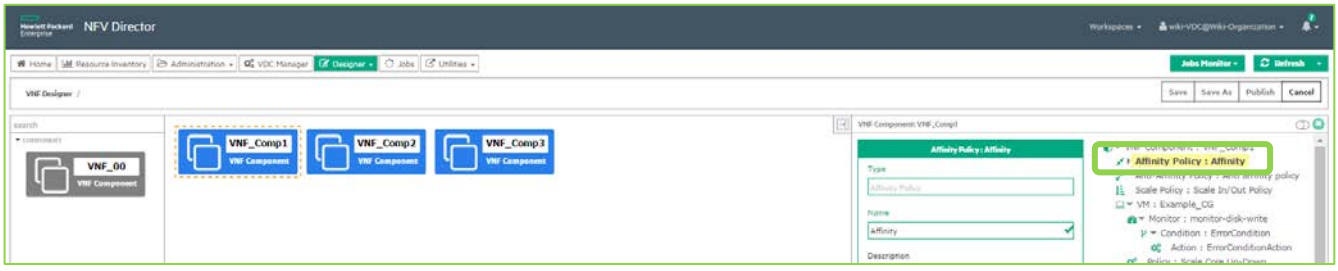


Figure 325: the policies present in the VNF Components

To modify an existing `Affinity Policy`, click the policy present in the list of components of the element. After selecting the policy, the attributes window allows the user to modify the active fields.

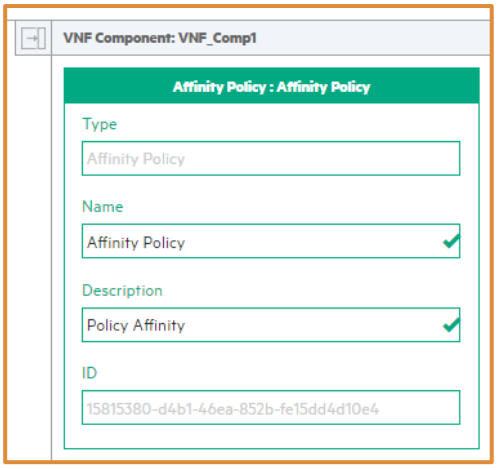


Figure 326: Affinity policies of the VNF Component

For this policy, we set the `Name` field with the value `Affinity`, and the `Description` field with the value `Affinity Policy`. All the fields must be fulfilled until the green tick is present on the right side of the box. When finished with the update of the fields, execute an **Update** of the component. This action was described in the previous chapter.

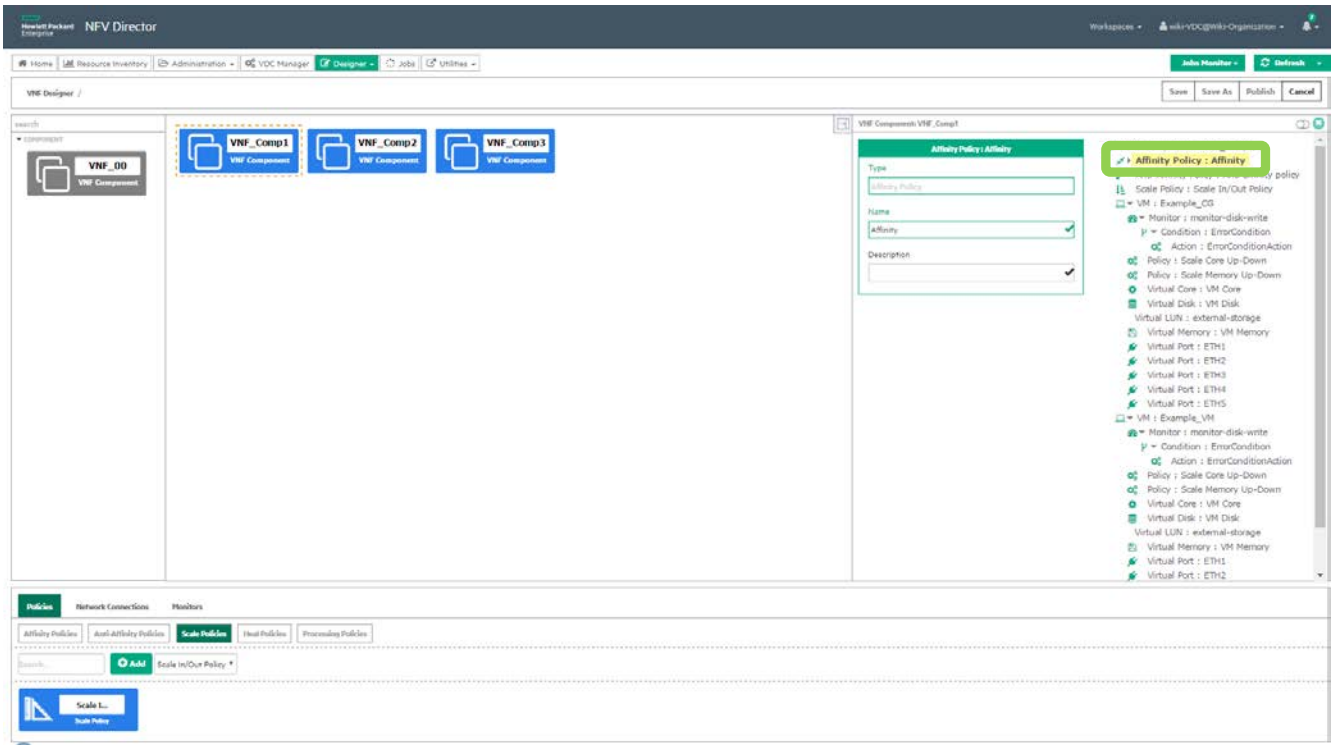


Figure 327: The Affinity policies in the VNF Component

3.2.4.2 Modifying Anti-Affinity Policies

An Anti-Affinity Policy allows us to indicate where and over what artifact the assigning of resources is going to take place. At this level, the Affinity policies are limited to the ones that were created in the components previously.

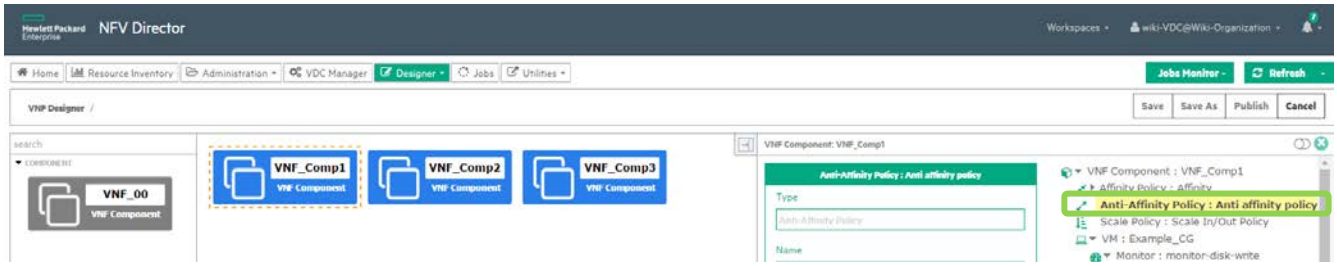


Figure 328: Modifying the Anti-Affinity policies

To modify an existing Affinity Policy, click the policy in the list of components of the element. Then the attributes window allows the user to modify the active fields.

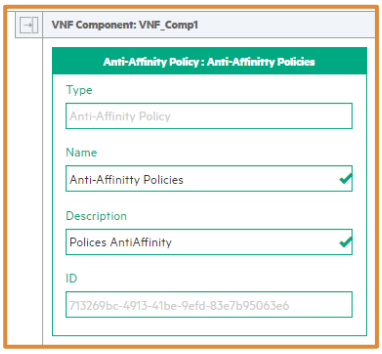


Figure 329: Attributes of the Anti-Affinity policies

For this policy, we set the `Name` field with the value `Affinity`, and the `Description` field with the value `Affinity Policy`. All the fields must be fulfilled until the green tick is present on the right side of the box. When finished with the update of the fields, execute an **Update** of the component. This action was described in the previous chapter.

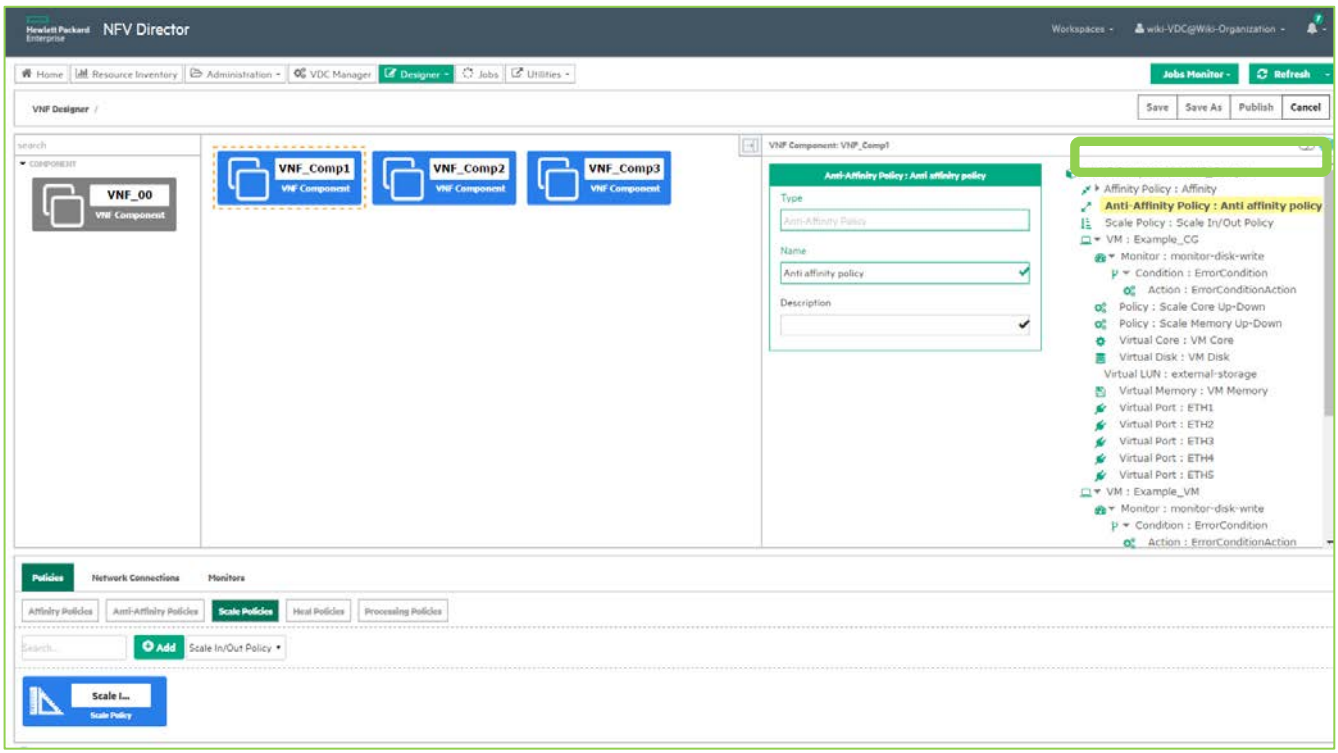


Figure 330 : The elements of an Anti-Affinity policy

3.2.4.3 Adding Scale Policies

The Scale policies are a set of orders and presets that conduct and manage the escalation processes over the different elements of the system. To clarify what types of policies we use and which are the best to be applied depending on the needs of the user, we will go over the scaling policies nature.

Scale Up:	Acts when a specific category's attribute of an artifact need to be dimensioned to an upper value, so this policy is going to act over elements as CPU or Memory.
Scale Down	Acts when a specific category's attribute of an artifact need to be dimensioned to a lower value, so this policy is going to act over elements as CPU or Memory.
Scale In:	Acts when an artifact needs to be eradicated in all its conditions and states. This type of policies permits the deletion of a number of elements, all of them equal to the artifact that acts as target of the policy.
Scale Out	Acts when an artifact needs to be cloned in all its conditions and states. This type of policies permits the creation of a number of elements, all of them equal to the artifact that acts as target of the policy.

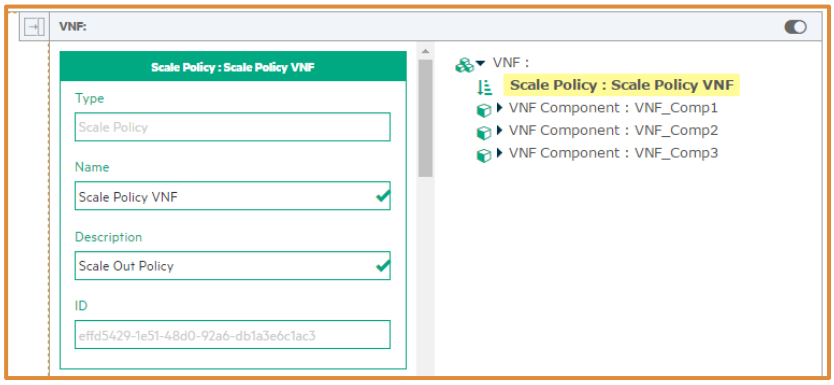
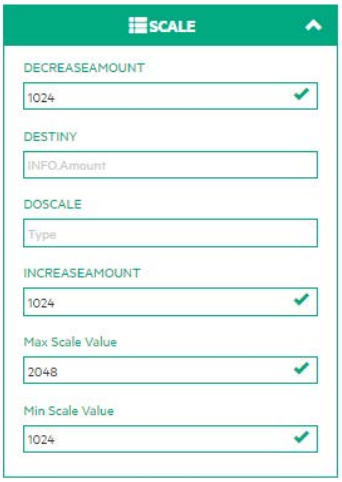


Figure 331: Scale policies present in the VNF

Note that the policy that will be created is going to be applied over the VNF that the user is creating. As you can see in the image above, on the right side, you can see the different elements that compose the future VNF. The Scale Policy is an element of the VNF, not an element of one of the components of the VNF, in this case, `VNF Component: VNF_Comp1`, `VNF Component: VNF_Comp2`, `VNF Component: VNF_Comp3`.

3.2.4.3.1 The Scale Up and Scale Down policies

The policies Scale Up and Scale Down are the responsible to extend or shrink specific components of the element. They are usually related to the `Core` and `Memory` elements of our Virtual Machines, when a Scale Up or Scale Down operation is triggered, the operation will check for the presence of these policies. If some policy exists, the operation will read the policy to apply it. The category that configures the policy is `SCALE`. Inside this category, we should configure the following attributes:



`DECREASEAMOUNT:` The amount of unities that are going to be eliminated. For this policy, it will be erased of the memory. In this case, 1024 Mb.
`DESTINY:` The category and attribute that is going to be modified by the policy. In this case the "Amount" of memory in Mb, reflected in the category "INFO".
`DOSCALE:` Not editable by the user.
`INCREASEAMOUNT:` The amount of unities that are going to be enhanced. For this policy, it will be created for the memory. In this case, 1024 Mb.
`Max Scale Value:` The maximum amount of the specific resource that can be reached through a scale operation, in this case, 2048 Mb.
`Min Scale Value:` The minimum amount of the specific resource that can be reached through a scale operation, in this case, 1024 Mb.

Note that the Scale Up/Down policies are implemented by defect in the base components. Keep in mind before starting a Scale Up/Down operation is that the policy is going to act without knowing if the situation on the OpenStack platform can afford what is expected by the policy. This means that, to guarantee the escalation, the user should be sure that the resources present in the OpenStack platform are enough to carry out the escalation, the limitation of the resources in the OpenStack platform must be checked by the user.

3.2.4.3.2 The Scale Out and Scale In policies

The Scale Out policies in the VNF Designer are Scale Out policies. This means that the component can be duplicated or cloned. The policy is going to allow the user to duplicate the VNF if necessary. The maximum number of clones reachable is set by the `Max Scale Value` attribute in the `RANGE` category. In this case the value set is `10`, so, when the policy will act, the VNF can be cloned ten times.

To create a new escalation policy over a Virtual Machine, first we should have a VM artifact in our work space (Third section of the Designer), with all its attributes and elements correctly filled. Once we have our VM, we need to go to the bottom of the web page, click **Policies**, and we will be able to see the below screen:

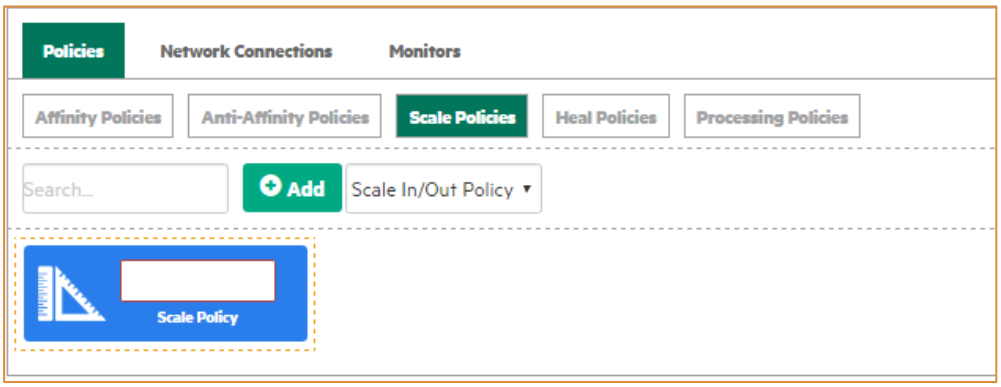


Figure 332: Adding Scale policies to the VNF

Once we see this screen, we can create the policy by clicking 

. The next step is filling the attributes of the policy and setting the target and name for the policy.

We should keep in mind that **the escalation policies should be set at the proper level to get the desired effect**. We have two options to create the escalation policies: Creating the escalation policy at component level, and creating the policy at VNF level:

> *Component level*: When we set a Scale Out/In policy at this level, the escalation operation will be applied to the elements that conform the component. This means that the escalation is going to take place over the Virtual Machines of the component, only over these machines, and only over the original template of the Component. **The modifications over the instances will not be reflected in the escalated elements.**

For example, if we have a Component with One VM, and a Scale policy with an `Incremental Value` of `1`:

- The user starts an escalation operation, the VNF Component will create another Virtual Machine cloning the one that already exists.
- At the end of the first escalation operation, the user will have two VMs over the same component.
- Later, this VNF Component needs to grow again and the user starts another escalation operation.
- When the process has finished, the user has three Virtual Machines, due to the escalation process is performed over the original design of the VNF Component, not over the result of the first escalation process.

> *VNF Level*: When we set a Scale Out/In policy at this level, the escalation will be applied over all the components of the VNF. So, if we configured an `Increment Value` of `1`, each component of the VNF will be duplicated by cloning one time. Basically, we will reproduce our VNF structure one time, including the Scale policies present in the VNF Components. These policies are going to be executed, too, when we trigger the escalation operation.

Notice that an escalation is never going to take place if the `Decrement Value`, `Increment Value` and the `Min Scale Value` are in conflict. The following cases clarify what we mean by conflict:

A `Scale Out` operation at VNFC level, because we will use number of Virtual Machines: if our policy was set at VNF level, we would talk about number of VNF Components, but the behavior of the policy would be the same.

Number of VM	Decrement	Increment	Min	Max	Conflict
1	1	1	1	1	`Min` and `Max` has the same value, no Scale Out will be performed due the number of VM already suits the `Max` value.
2	1	1	2	3	`Max` value is not enough to settle the amount of VM that the operation will create with and increment of one. Four VMs will be created, with a `Max` value of 3. No Scale out will be performed.
3	1	1	3	6	The Scale Out will be performed only one time. With this configuration, the Scale Out can only be executed once in a row.

We will implement our escalation policies for our VNF at the level that shown in the image below. It will only act over the `VNF Component`, which is part of the component.

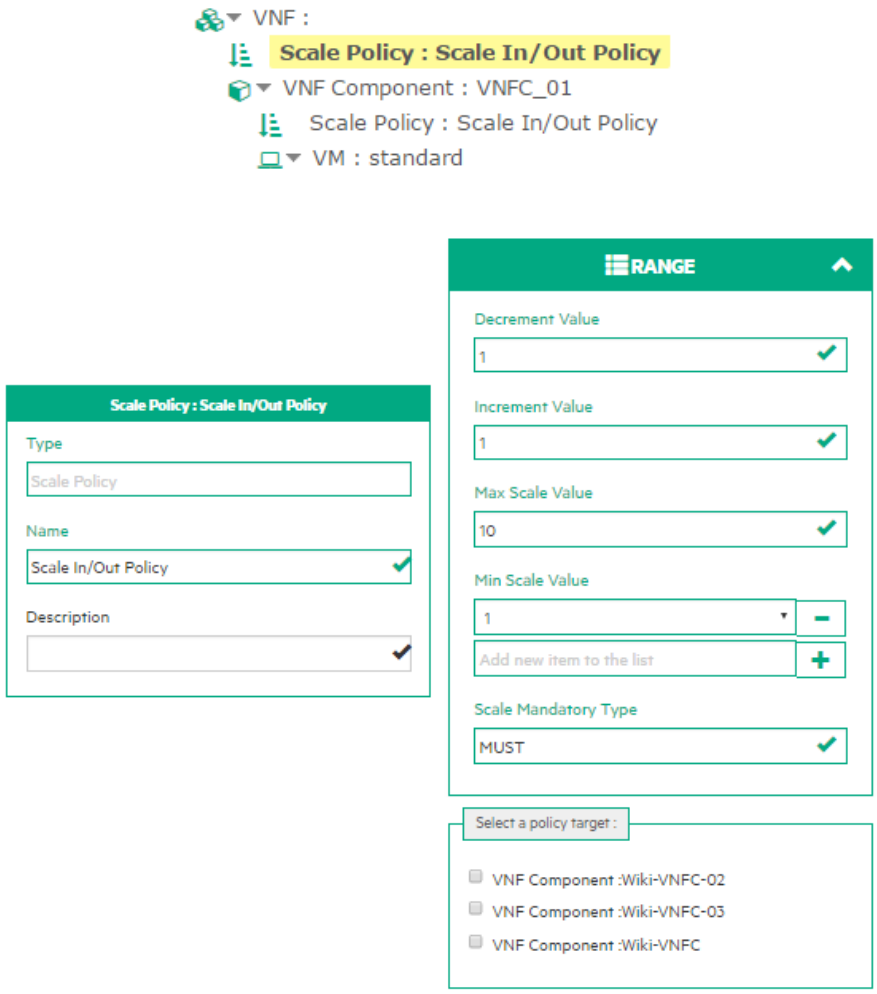


Figure 333: Editing the attributes of a Scale policy

For this policy, the fields `Name` and `Description` in the category `GENERAL` have been filled with the values `Scale Policy` and `Policy to scale VM` respectively. And in the category `RANGE`, we are going to construe the value in each field.

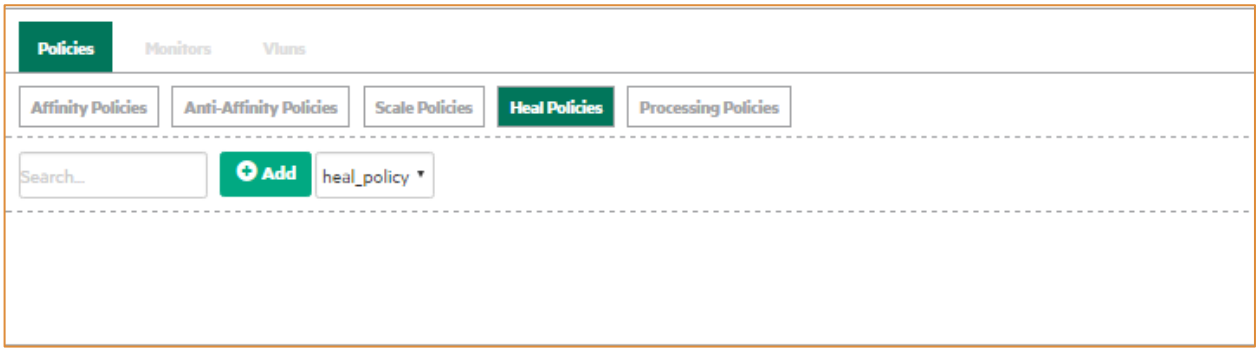
The `Decrement Value` and `Increment Value` are related to the number of VMs that are going to be duplicated or erased. If we have a value of `1` as decrement value, it means that in case of a `Scale IN`, the number of VMs that are going to be erased is only one. In case of increment, the logic to apply it is the same. For a value of `2`, if we have one VM, we will end up having three VMs. In case of having two VMs, we will finish with six VMs.

The difference between selecting `MUST` or `SHOULD` as the value for the `GENERAL.Type` is that in case we have selected `MUST`, if the system is close to running out of resources during the assigning, the application will throw an error message. If the value is `SHOULD`, the application will throw a warning message, and continue with the execution without stopping. In this case, the value of the `Type` attribute is `MUST`, so if the resources available are close to be depleted in the moment of the assigning, the application will throw an error. In other case, the execution will continue.

We should select at least one target for the policy. We are designing a VNF, so our target can only be a VNF Component. To select one, left-click in the checkbox in the list of VNF Components related to the VNF. After selecting one, we are done with the configuration of the policy.

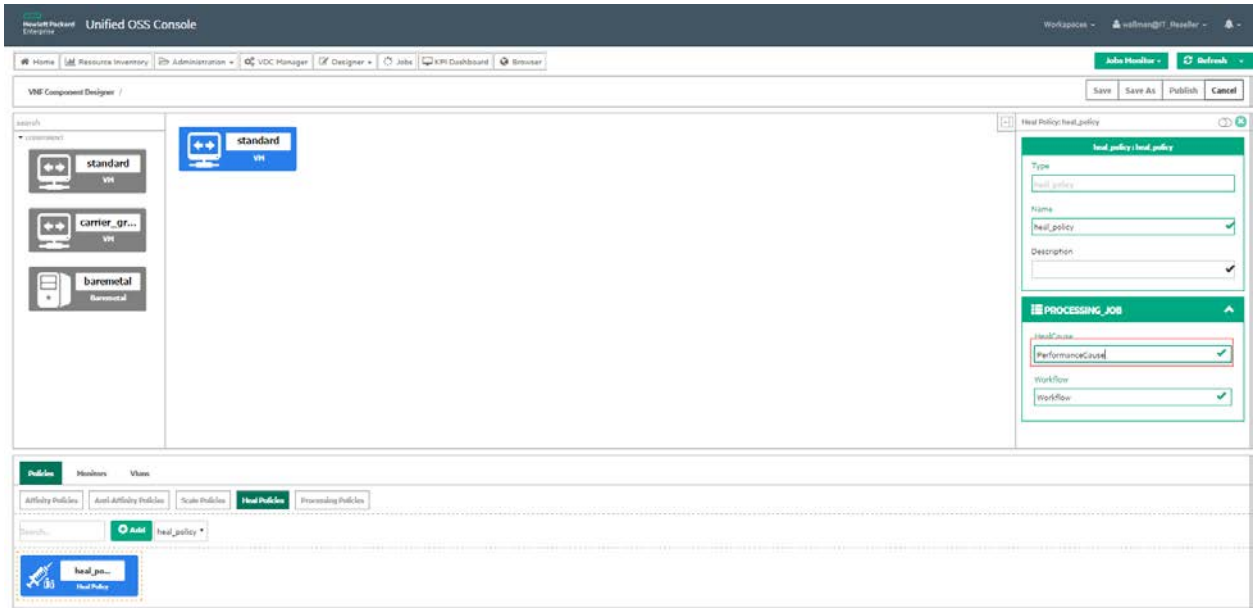
3.2.4.4 Adding Heal Policies

The heal policy is used for defining how to Heal the VNF or VNF Component. To add a heal policy, first select the **Heal Policies** tab in the bottom area of the designer.



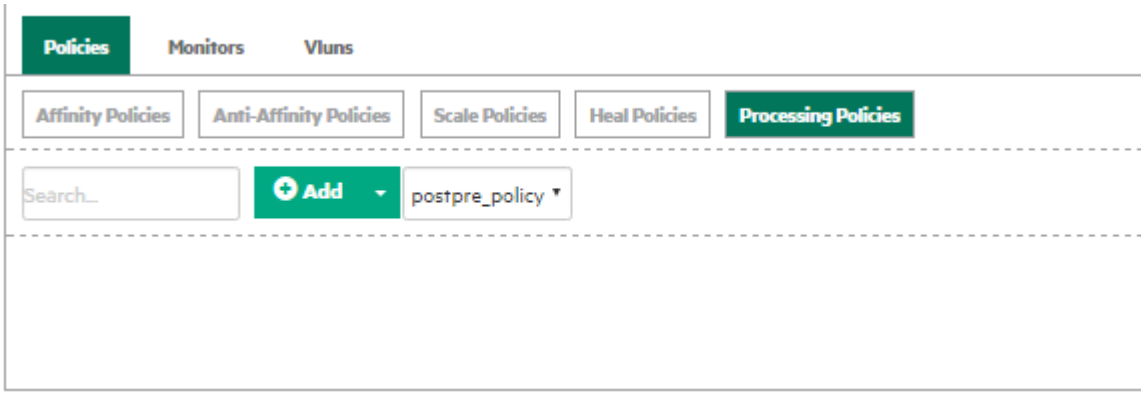
Then click **Add** to add a heal policy to the current VNF Component.

In the inspector area, customize the `HealCause` attribute of the heal policy.

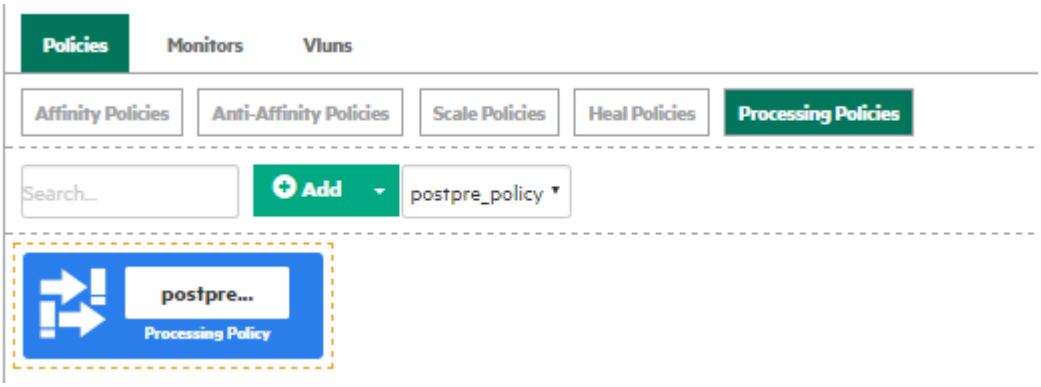


3.2.4.5 Adding Processing Policies

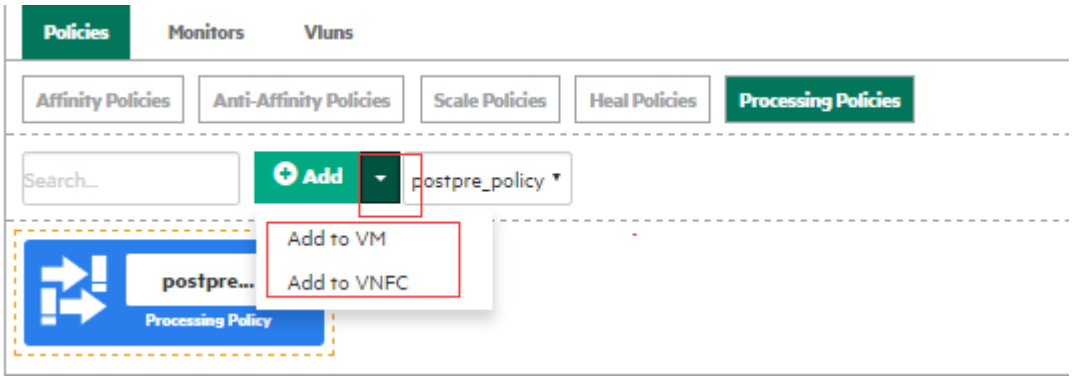
To add a processing policy, we should first select the **Processing Policies** tab in the bottom area of the designer.



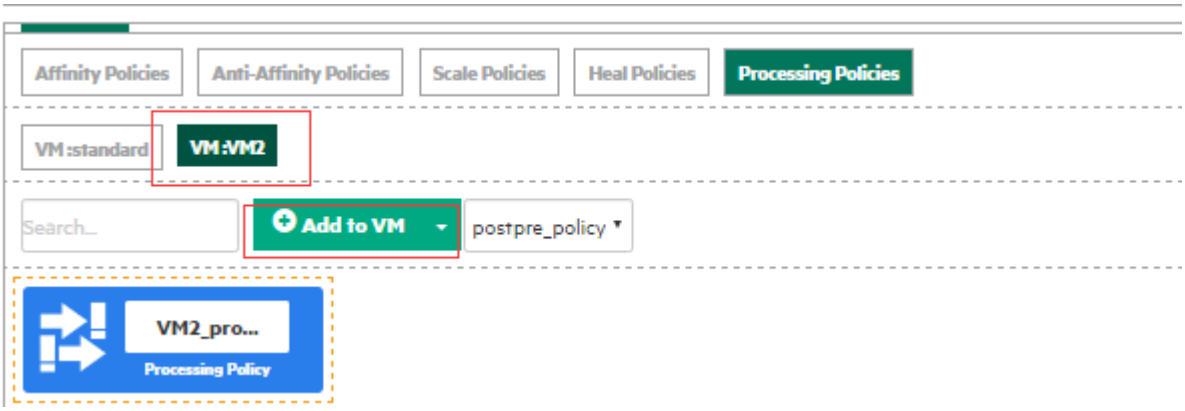
Processing policies could be added to both VNF Component level and VM level. By default, we can add the processing policy to VNF Component level when we click **Add**.



There is a drop-down icon at the left side of the **Add** button. Click it and you will see a list of two items.



Click **Add to VM**, then you can add the processing policy to the VM level. Select the target VM tab, and click **Add to VM** , then you will add a processing policy to the VM.



The image above shows how the Pre/Post processing policies will be created, all the attributes editable are wrapped in the category "PROCESSING_JOB", a Pre/Post-processing has to have a workflow to be processed, and it should have an operation as target for the triggering of the policy, for this policies is also possible to identify an order of execution, a complex task could have more than one Workflow or process involved. We are going to explain what each attribute of the category “PROCESSING_JOB” is and how these attributes should be filled to have a successful use of the policy.

- Type: The type only can take two values: `PRE` or `POST`, corresponding with one of the two types of actions that will take place when the policy will be executed.
- WorkFlow: The policy needs an element that contains all the logic of the process that is going to be executed. This mandatory element is implemented through a Workflow that is customized for the specific operation. This means that a Pre-processing policy can have more than one workflow prepared to be executed. Each workflow will have a Pre/Post-processing policy assigned to be executed, so the same entity could have several Pre-Post policies related, but **entities cannot share their processing policies with each other**.
- Operation: The `Operation` attribute represents the operation from which the policy will be triggered. These operations are `Deploy`, `Undeploy`, `Scale Up`, `Scale Down`, `Scale In` and `Scale Out`, basically the core operations of the solution.
- OrderBy: This is a numerical attribute. We can introduce the order of execution that should be followed during the execution of the operation. If we have more than one policies related to the same operation, we can sort the execution introducing a number in this attribute. This way, if we introduce the number 2, our policy will wait for the first policy to be executed, and only after that will out policy start its execution.

3.2.5 Adding Network Connections to the component

We will cover this topic in another section due to the peculiarities of this elements and its function. The Network connections refer to the elements that are going to be connected through an End_Point. An End_Point is the point of connection between higher components. This means that the communication that is going to take place between entities needs elements to dictate what can be accessed from other entities.

To create a new connection, click Network Connections at the bottom Menu of the designer. After that, click 

. The network connection will be created with the editable fields empty, as in the image below on the left.

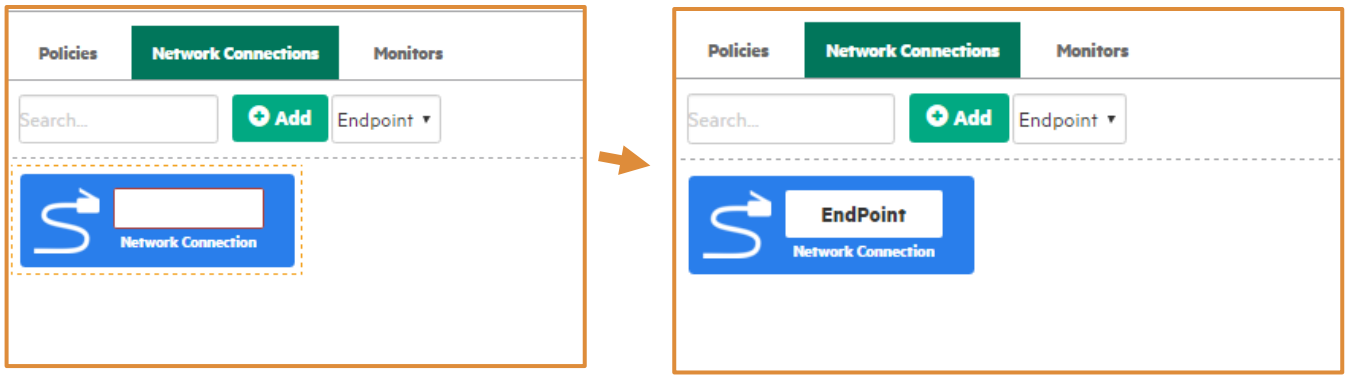


Figure 334: Adding a new EndPoint to the VNF

The designer allows us to create Network Connections without limit, but it makes no sense connecting different components, elements or entities more than one time. Having duplicate connections is considered a bad practice. The user can create an End_Point for each element if preferred, but it is not an optimal approach. The most optimal method is to create an End_Point for various elements of the same component. This will be explained later in the document.

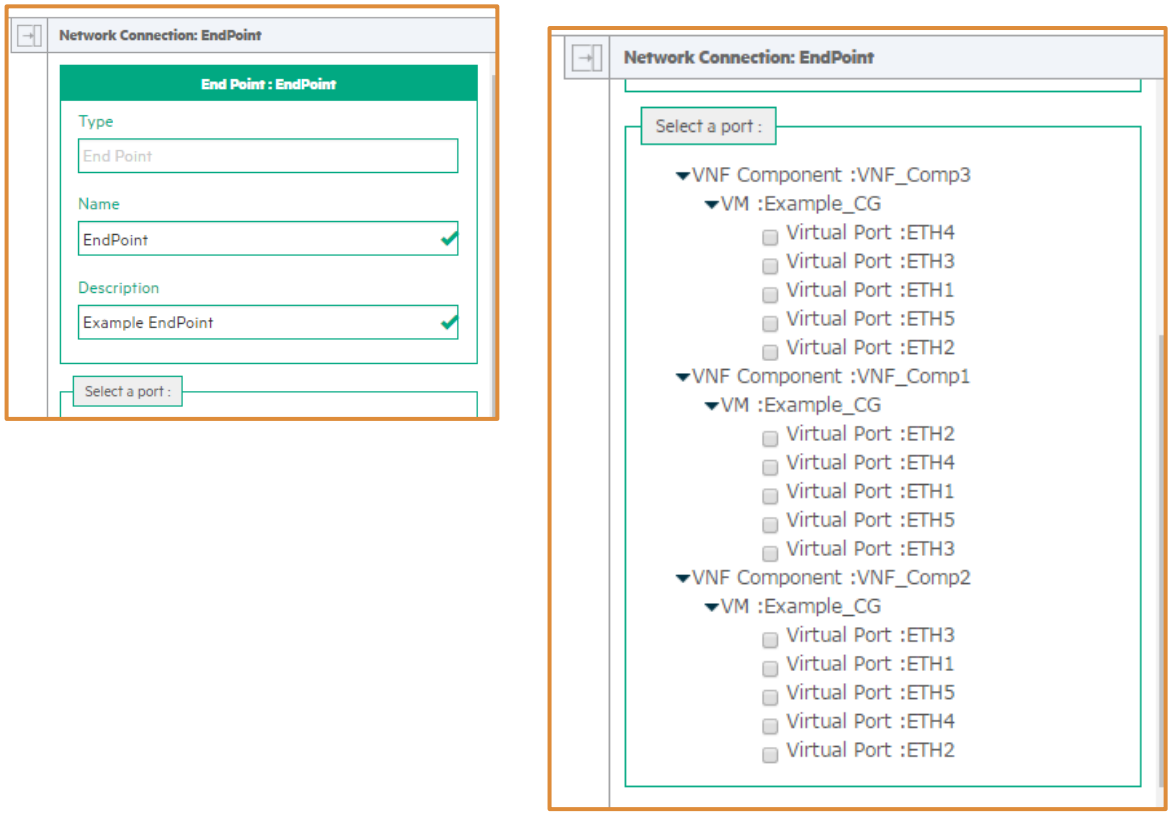
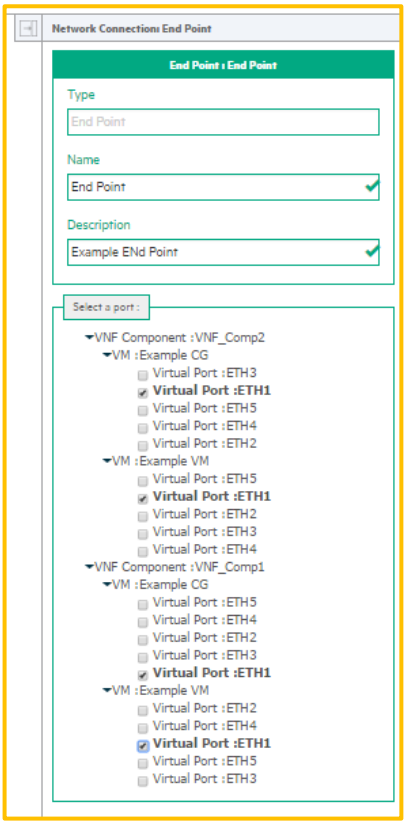


Figure 335: The attributes of an EndPoint

In the example case, our VNF is going to have two VNF components. As in the image above, our VNF components are named `VNF Component: VNF_Comp1` and `VNF Component: VNF_Comp2`. Both components have two Virtual Machines. Each component's Virtual Machines have five configurable Virtual Ports to be connected to the EP of other components or elements.

At this moment, the user should decide between creating a unique `End_point` for the VNF that is being created, and creating more than one EPs and configure each one of them based on the specific needs of the use case.

If we decide to create a unique EP for the VNF component, meaning that all the components that will try to connect to the future VNF that it is being designed by the user will do it through the unique EP of the component. One way to connect the EP to all the VMs present in the two "VNF components" that conform our VNF is as follows.



For this End Point, the `Name` and `Description` attributes have been filled with the values `End Point` and `Example End Point`, respectively. As we explained in the previous chapter, to have a unique EP connecting all the VMs of our VNF components with the VNF being created, we need to connect at least one Virtual port of each machine to the End Point.

As you can see in the image on the left, we selected the `Virtual Port: ETH1` of each Virtual Machine. In this case, and only for didactic purposes, the VNF Components and Virtual Machines are equal. Normally, each component reflects different configurations depending on the future use and characteristics of the VNF.

With this configuration, all the communication between the VNF and the Virtual Machines of the Components will take place through the End Point that we are creating.

The designer allows to create more than one connection with the same Virtual Machine, but this is a bad practice, not only because we are duplicating a connection, but also because a Virtual Port only manages one connection, and does not permit more than one element connected.

Figure 336: First possible way to connect the EPs of a VNF

The other way to proceed with the creation of EP for our VNF is to create more than one End Points to manage the communication of the VNF. This can be done by creating one EP per VNF Component, or by creating an EP per each Virtual Machine. The decision only depends on the user's needs.

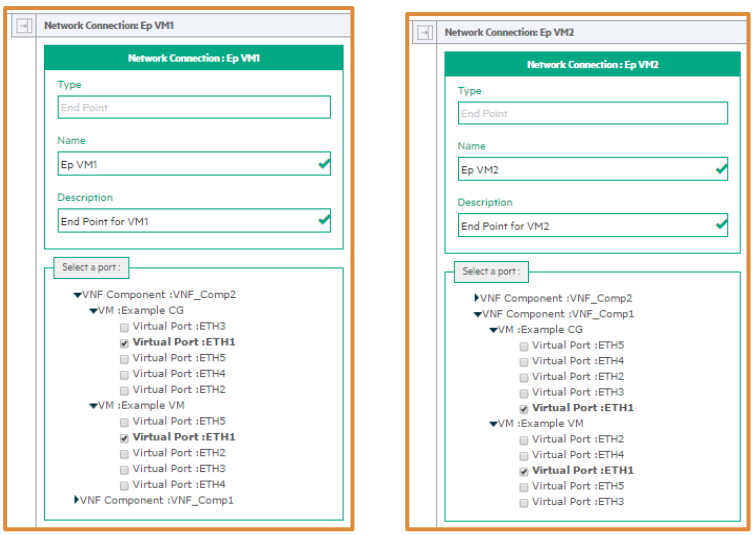


Figure 337: Second possible way to connect the EPs of a VNF

The previous image shows how we can connect two End Points, each one of them connected to the two Virtual Machines present in each VNF component. When the VNF needs to reach the first VNF Component (`VNF_Comp1`) the communication will take place through the End Point `Ep VM1`. When the VNF tries to connect to the second VNF Component (`VNF_Comp2`) it will use the End Point `Ep VM2`.

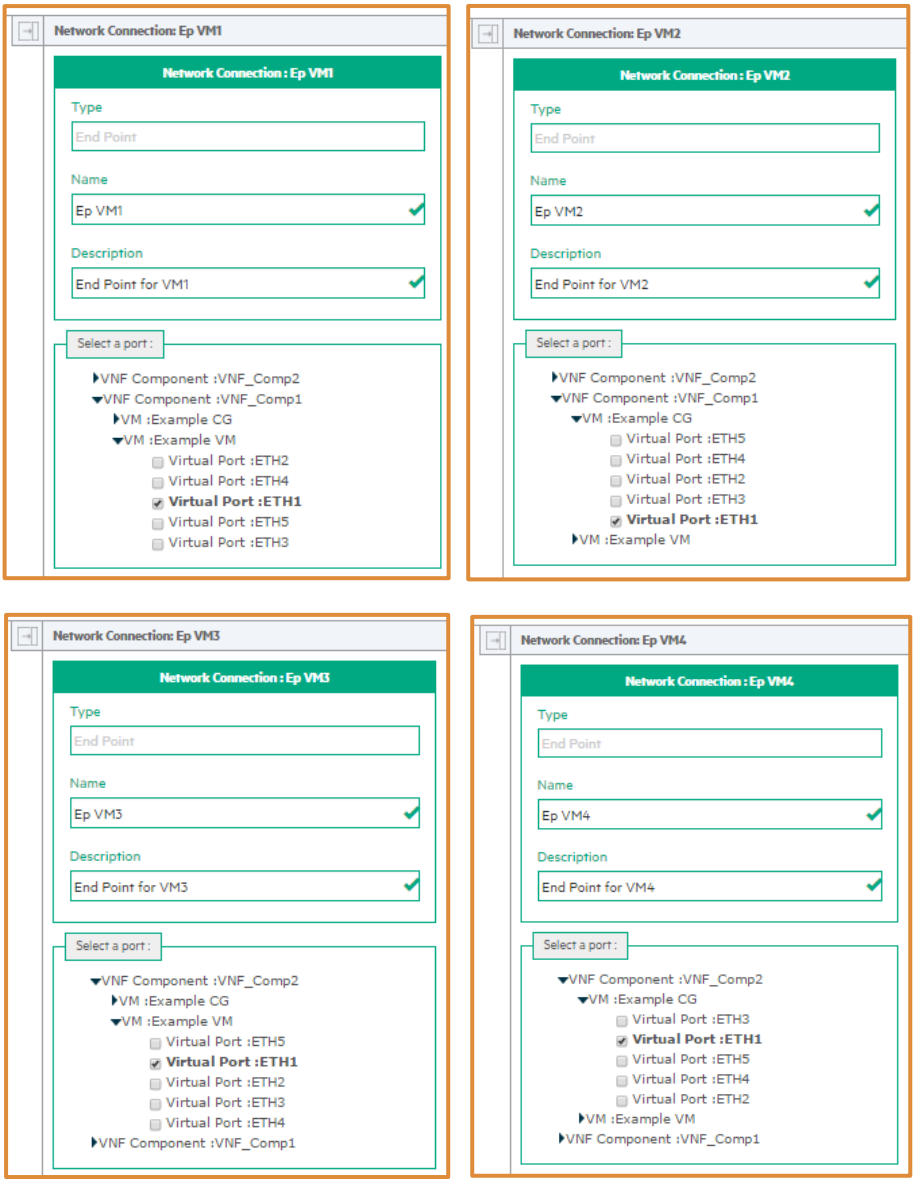


Figure 338: Third possible way to connect the EPs of a VNF

The previous image shows how we can connect four End points. Each one of them is connected to the one Virtual Machine present in each VNF component. In this case, when the VNF needs to reach the `VM:Example VM` of the first VNF Component (`VNF_Comp1`), the communication will take place through the End Point `Ep VM1`, if the VNF tries to reach the second Virtual Machine of the same component, `VM:Example CG` the communication will take place through the end point `Ep VM2`. In case that the VNF try to reach the `VM:Example VM` of the second VNF Component (`VNF_Comp2`), the communication will take place through the End Point `Ep VM3`, if the VNF tries to reach the second Virtual Machine of the same component, `VM:Example CG,` the communication will take place through the end point `Ep VM4`.

Once a Virtual Port is in use by some End Point, it will not be available to be connected to other EPs. The configurations previously shown are the common and recommended.

3.2.6 Adding Monitors to the component

Monitors are elements that allow the user configure an observer for the element monitored. This means that depending on how we configure our monitor, it will receive different information about the behavior and changes of the component monitored. This monitoring has the objective to react when the system needs some resources, mainly solving this lack with the launching of escalation actions.

A Monitor must be connected and related to a Virtual Machine. If the user does not have a Virtual Machine already instantiated in the work Space (third part of the Designer), the Monitors tag will not be shown as Active, so we are not going to be able to create a Monitor.

As you can see in the image below, once the user has created a VNF, this element has all the monitors implemented in the Virtual Machines present in the VNF Components that conform the VNF. In this case, two components, with two Virtual Machines for each one of them.

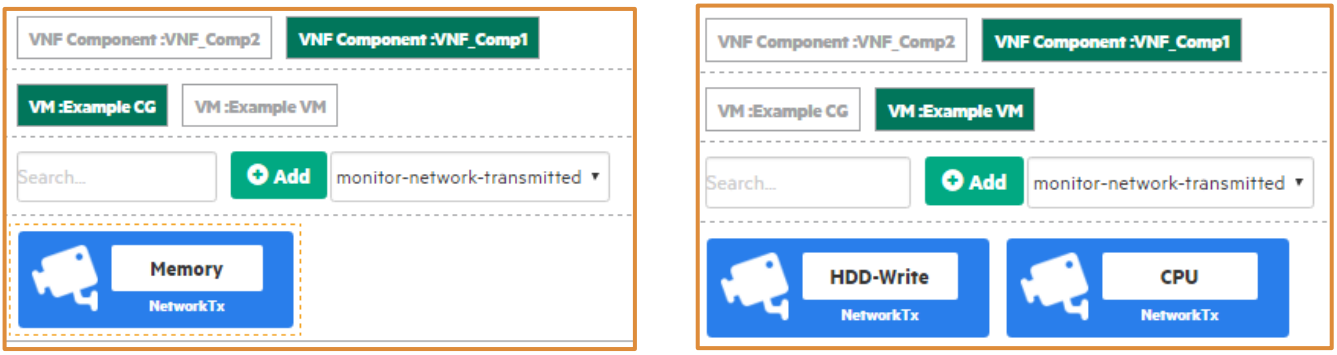


Figure 339: Different Monitors owned by some components of the VNF

If the user wants to create a new monitor over one of the four Virtual Machines present in the VNF, the user only needs to select which VM is going to be the owner of the monitor. To select the Virtual Machine, select a VNF Component: either `VNF_Comp1` and `VNF_Comp2`. After selecting a VNF component, select the Virtual Machine that is going to harbor the Monitor.

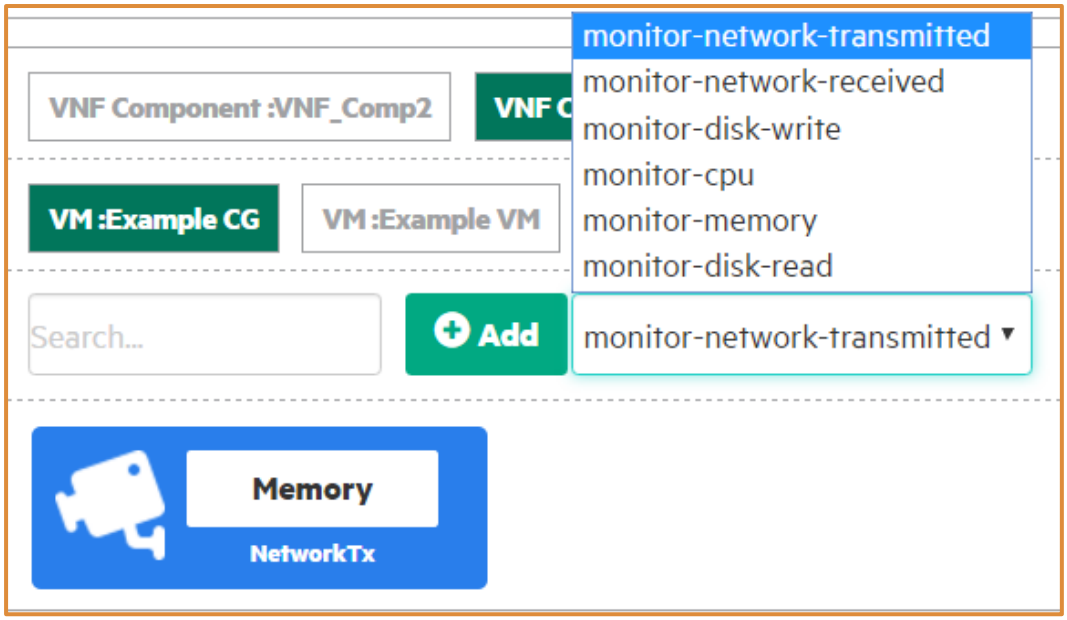


Figure 340: Type of Monitors available to be added

If the user has properly selected a Virtual Machine, the user will be able to create a Monitor of the type listed in the image above. As you can see in the image, the Monitor, whatever the kind, will be created under the influence of the VM :Example CG Virtual Machine. In the figure, we can see all the types of possible Monitors that the application allows us to create. To create one type of monitor, select the type and click Add. This action will add a Monitor of the type selected to the Virtual Machine, and it will pair that monitor to the element determined by the Monitor's type. A monitor of type `CPU` will be matched with the CPU related to the Server that is going to be used with the Virtual Machine in use. The rest of the monitors operate the same way.

3.2.6.1 Types of Monitors

All the attributes of a Monitor, from our point of view are reduced to the `Name` and `Description` of the element. This is because we have already chosen the type, and the element which is going to be monitored. The attributes that remain empty are those two previously mentioned. The other two important categories to configure are `Action` and `Condition`. The way to treat these categories is discussed later in the chapter.

The types of Monitor we can deploy over our Virtual Machines are:

Monitor Disk Write:	Monitors writing operations over the Virtual Disk associated to the Server related to the Virtual Machine.
Monitor Disk Read:	Monitors reading operations over the Virtual Disk associated to the Server related to the Virtual Machine.
Monitor CPU:	Monitors operations over the Virtual CPU associated to the Server related to the Virtual Machine.
Monitor Network Transmitted:	Monitors transmission operations over the Virtual Network related to the Virtual Machine.
Monitor Network Received:	Monitors the messages received through the Virtual Network related to the Virtual Machine.
Monitor Memory:	Monitors operations over the Virtual Memory associated to the Server related to the Virtual Machine.

A Virtual Machine can have one type of Monitor for each kind of artifact related to it.

Figure 341: All the Monitors assigned to one of the Components of the VNF.

In the image above, we can see a Virtual Machine named `VM:Example CG`, with five different Monitors configured.

3.2.6.2 Configuring error Actions for Monitors

Monitors need to be configured to start their activity in case some attribute of the monitored element reaches a certain state, or some of its attributes exceed a quantity or surpass a number of communications. To achieve this behavior, the monitor has a `Condition` and an `Action` attribute that need to be filled. Unlike the general attributes of the monitor, `Condition:ErrorCondition` and `Action:ErrorConditionAction` work together as a trigger. When the condition is met, the action will take place.

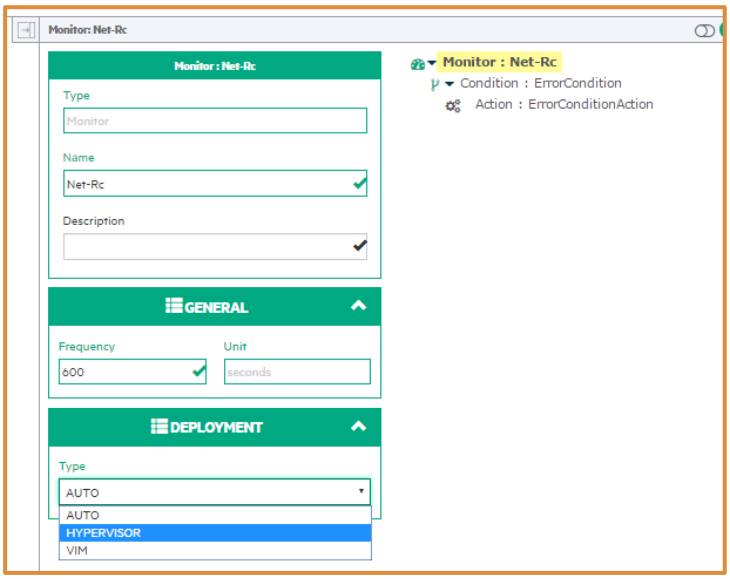


Figure 342 : Attributes of Error Action in a Monitor

As you can see in the image above, the monitor has the typical attributes `Name` and `Description`, and the attribute `Type` is not editable, as usual. To change the value of the previous fields, click in the field's box and introduce a valid name and description for the monitor.

The `GENERAL.Frequency` attribute refers to time gap between each capture by the monitor. It is set in milliseconds. In this case, the value automatically set is `600`. To change the value of the attribute, proceed as explained in the previous chapter.

The `DEPLOYMENT.Type` attribute refers to the element that is going to be monitored. In the image, the artifact selected is the `Hypervisor`. You can see the other two possible options. If the user selects `VIM`, the monitor will target this element for monitoring. If the user selects `AUTO`, the system will decide which element is going to be monitored.

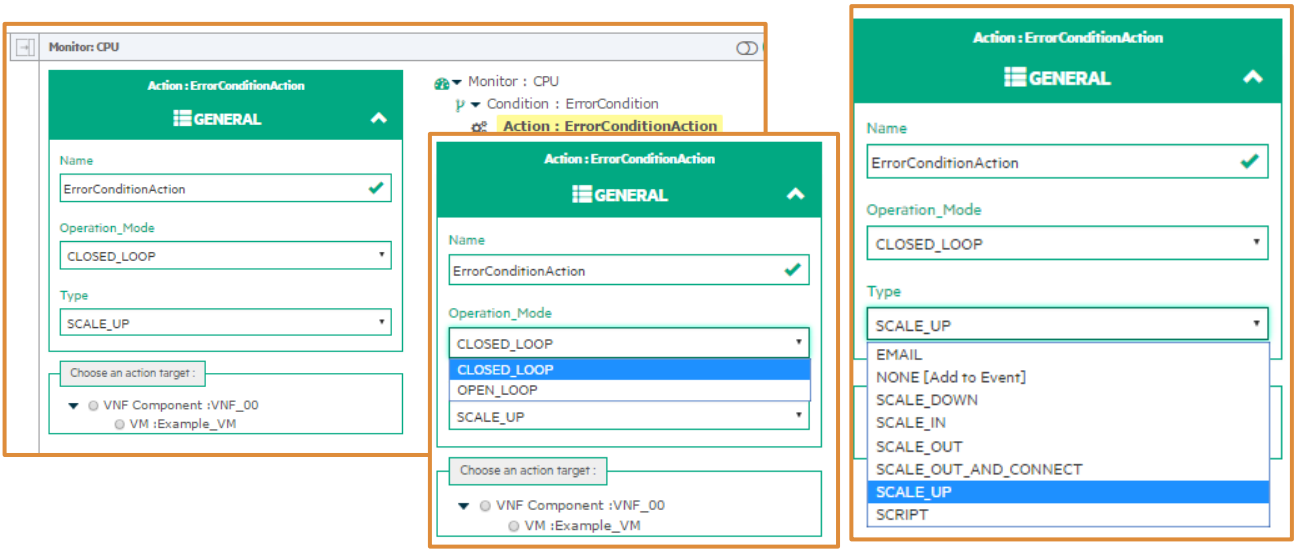


Figure 343. Attributes to configure an Error Condition Action in a Monitor

In the image above, we can see the different attributes of the `Action:ErrorConditionAction`. As always, we can see the field `Name` filled with the value `ErrorConditionAction`. After the `Name`, two attributes are present: `GENERAL.Operation_Mode` and `GENERAL.Type`.

`GENERAL.Operation_Mode,` can only take two values, `CLOSED_LOOP` and `OPEN_LOOP`. This means that if the value chosen was `CLOSED_LOOP`, the action to take is not going to wait for the user's operations to end. For example, if the monitor is configured to launch a `SCALE_IN`, the monitor will launch the scaling process without respect the running processes of the user. If the user chooses `OPEN_LOOP`, the monitor will wait to launch the Action until the user's operations are finished.

The "`GENERAL.Type` it refers to the type of the operation that the monitor it is going to throw if the condition is met. We should take into consideration that the user can configure a monitor that will never be used. For example, the user creates a monitor that has – as target – a Virtual Machine with a `SCALE_OUT` value in the field `GENERAL.Type`, It implies that the Virtual Machine is the owner of an Entity Scale (which is an error, as a Virtual Machine has no child suitable to be the child of the Entity Scale policy associated to the VM. So, the Scale Out has no element to be escalated, there is no child for the Entity Scale policy), and it also implies that that this policy has an element acting as child that can be the target of the policy. This is a condition that can never take place. The `Scale_Out` operations are launched at least over a VNF component level. This way we always have a child element to be escalated.

As you can see, a monitor can be used over a wide number of operations, mainly scale operations. These operations were explained in the chapter *Adding Scale Policies*. The operations that were not explained in a previous section are:

- SCRIPT:
  Refers to the case when, for a specific Condition, the monitor must launch a Script and not start an operation.

- NONE [add to Event]:
  Refers to situations when CPU use breaches threshold or the disk is about to run out of space. In such cases, an alarm will be raised, then we will handle this alarm and will perform associated ACTIONs like `SCALE UP/DOWN/SCRIPT`.

- EMAIL:
  Refers to the case when the occurrence of an event must be notified to an entity or subject.

In the section Choose an action target, the designer allows us to choose which element is going to be monitored. In this case, the user can choose from three elements, the VNF that it is being designed, the VNF Component that is part of the VNF, and the Virtual Machine that is member of this VNF component. Note that if during the design we have more than one VNF components, or these components has more than one Virtual Machines, they will be listed in this section.

3.2.6.3 Configuring error conditions for Monitors

The monitors need to have configured a condition that will act as trigger for the action of the monitor. Such conditions are configured by an expression that includes some attributes, referenced by their exact name and the value of the attribute referenced. Also, it should reflect how the condition is going to treat the changes in the attribute, for example, when the attribute's value becomes greater than the value reflected in the monitor.

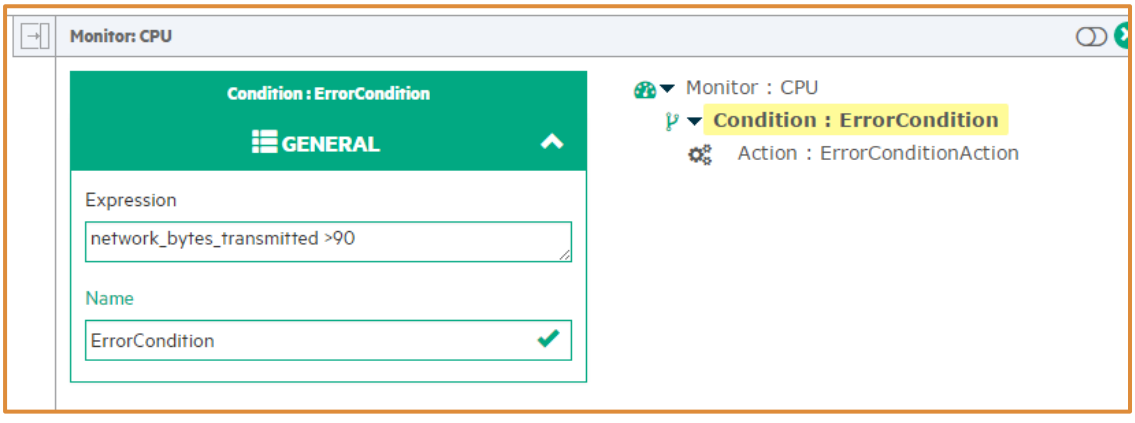


Figure 344 : Attributes to configure an Error Condition for a Monitor.

For the condition present in the Monitor Net-Rc, (image above) the attribute `GENERAL.Name` has a value of `ErrorCondition` and the `GENERAL.Expression` attribute has a value of `network_bytes_transmitted >90`, so, when the monitored element reaches 90 bytes transmitted through the network, the monitor will launch the operation present in the Action (in this case a `SCALE_UP`, see previous subchapter) `GENERAL.Type`.

To modify the value of the attributes, click in the box of the attribute and type a valid new value.

3.2.7 Deletion of elements of the designer.

There are various ways to delete a component in the designer. The user should not misunderstand the concept of delete and cancel in the designer. If the user's intention is to eliminate one component of the design, the user will erase unitarily the component selected. If the user's intention is to dismiss the design of the main component, the user will use the option Cancel of the top menu of the designer to delete all the design with all the components inside.

The first way to delete a component is by using the button present at the end of the top of the attributes menu:

Figure 345: One way to delete a component in the VNF Designer.

This icon is only available if the user has selected a component in the workspace. It would be highly unproductive if the users were able to erase the component they are working on before it has been created.

To finally perform the deletion, click The following window will be displayed:

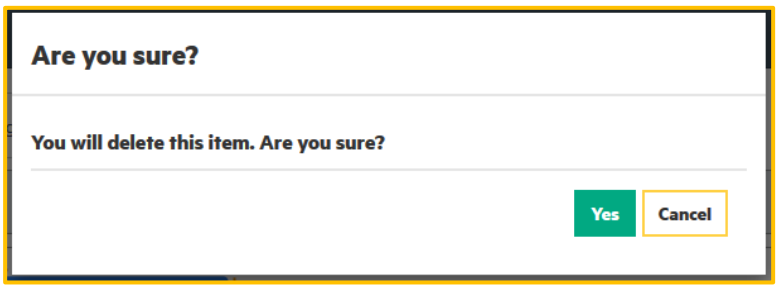


Figure 346: Confirmation window for the deletion of an element in the designer.

To delete the component, click Yes. The component element selected will be deleted, and no message or jobs are generated by this action.

3.2.8 The list of the component's elements

As we said before, the list of elements of the component permits the user to change the attributes of the element selected. In the images below, the user has selected different elements/artifacts. These artifacts have their own attributes, but they have common categories. This implies that some elements need to be fulfilled or configured before saving the component.

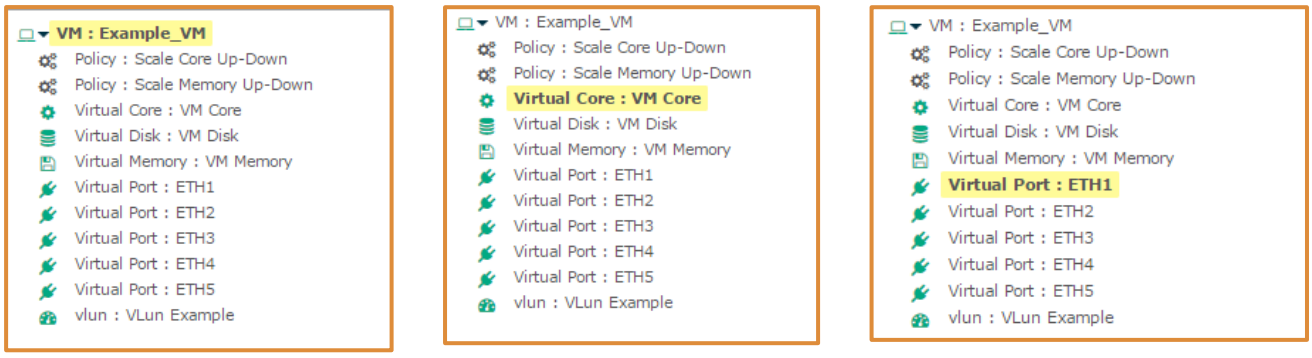


Figure 347: Different elements that conform the VNF

When explaining how to create policies of various types, we discussed how to change the values of the attributes of these elements. Below these lines are the attributes that are shown suitable to be edited after selecting the artifact in the list.

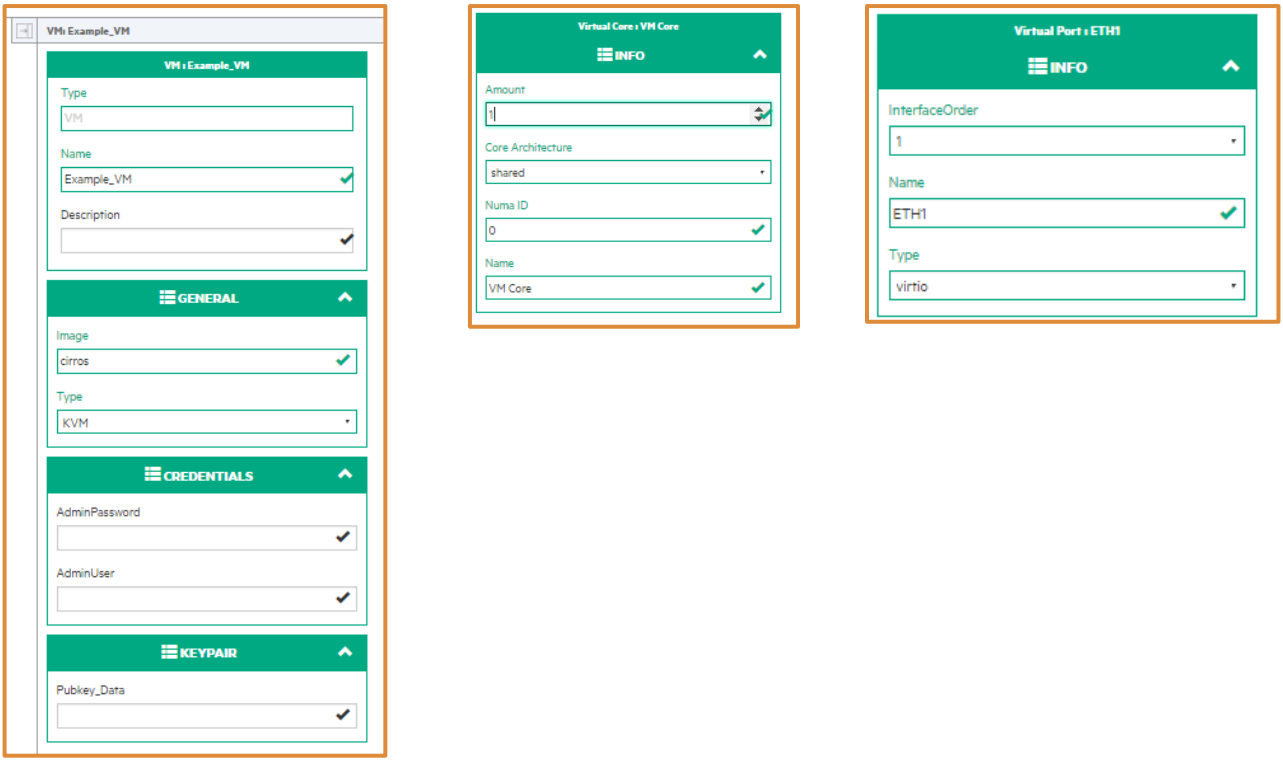


Figure 348: Categories of some elements of the VNF

If you run into any problems filling some attributes during the creation of the component, or if the component is not accessible from this list, it is not necessary to edit the component.

3.2.9 Publishing your component

Once we have finished designing our new component, in order to make it usable, we must save it before we can include it in a VNF. First, we should properly fill the `Name` attribute of our future component. To do this we should select our work space that represents the VNF component that is being configured.

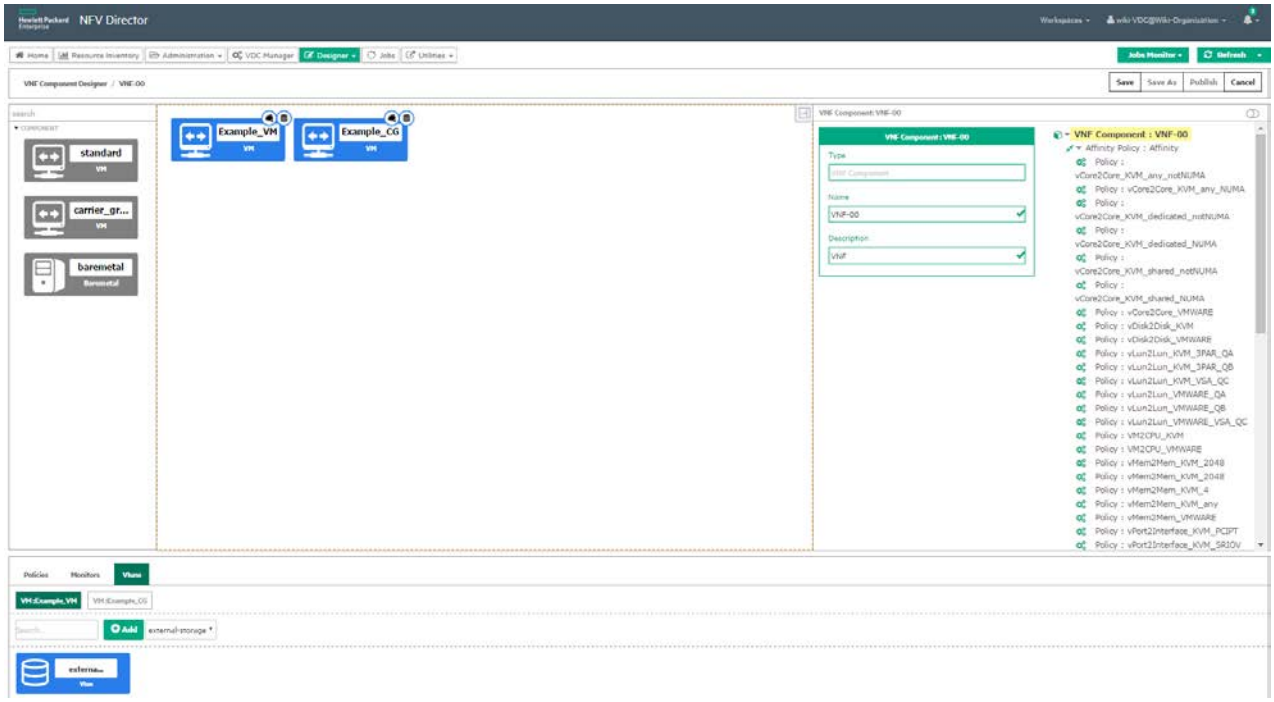


Figure 349: Save and Publish your VNFs

As we can see in the image above, the user gave as value for the attribute “Name”, “VNF”, this name is what will be shown in the “VDC Manager” when the user look for the component to be used, If we have completely finished fulfilling the different attributes for our specific purpose in each element, and we are pretty sure that we have all the elements needed correctly configured we will proceed to save the component.

To save the component, click Save at the top-right side of the web UI. The application is going to create the user’s component. After saving it, the component must be published to become available to be used in the ”VDC Manager”. The component is published by clicking Publish in the previously mentioned menu.

If the publishing was successful, when the user opens the “VDC Manager” and selects the VNF element, the component that has been published will be available as an element to be the target od operations that the “VDC Manager” can carry out.

3.2.10 Making the designed components visible

To make our VNF components visible for the VDC Manager, we should assign them to a VNF Group. Otherwise, it would be impossible for the VDC Manager to use these components.

To make these elements visible, the user must go to the Management section of the web platform’s top menu, and select the section VNF Registration & Management. Once there, we need to select our group and click Action. Then the user will see a list like in the image below.

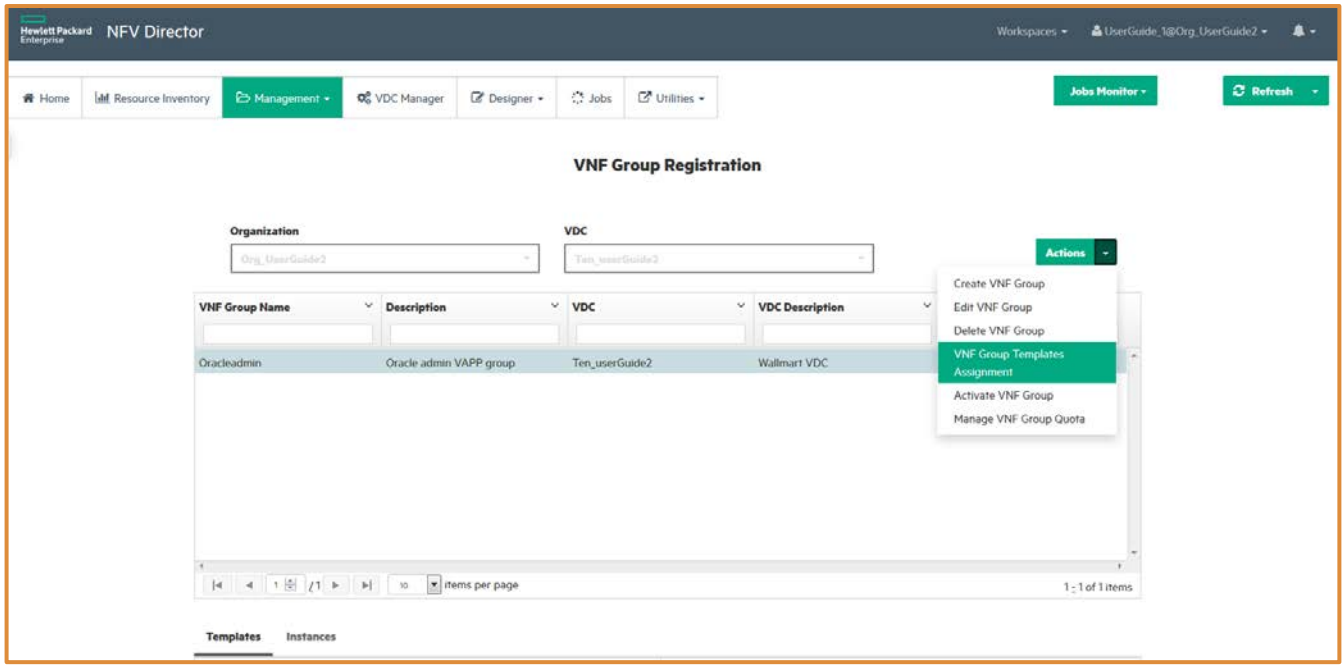


Figure 350: Adding our VNFs to the proper group to make them available to be used

In the list, the user must select VNF Group Template Assignment by clicking the element. Once selected, the user will see the following window:

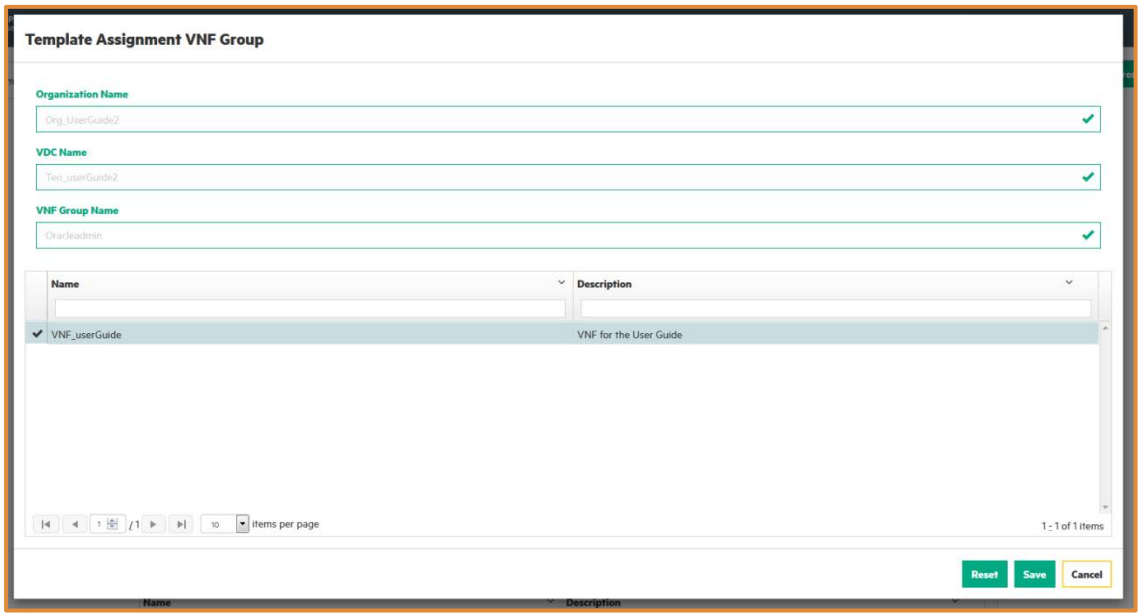


Figure 351: Configuration window for the addition of the VNF designed.

In the lower half of this window, the user can see the name of the VNF components and VNFs designed with the "VNF Designer" or with the "VNF Component Designer". To make such elements usable by the VDC Manager, select the two of them. If the user has more elements of the two types in the list, tick or untick the box at the left of the name of the components to select or unselect them.

After selecting the items, to make the changes effective, the user should click Save at the right bottom corner.

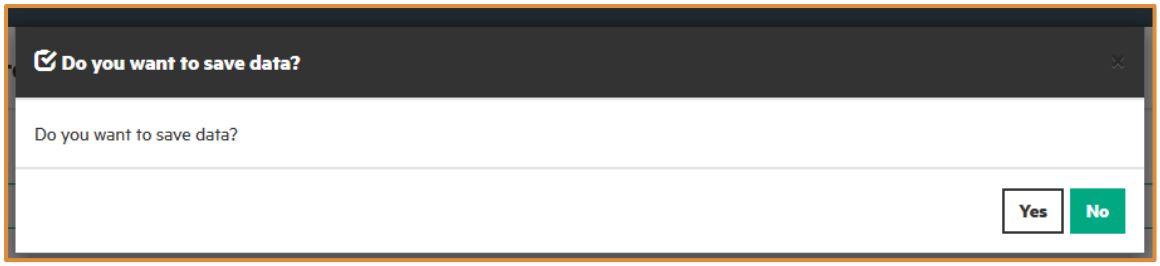


Figure 352: Confirmation window for the addition of the VNFs

If the assigningt is successful, the user will see a message as the one in the image below.

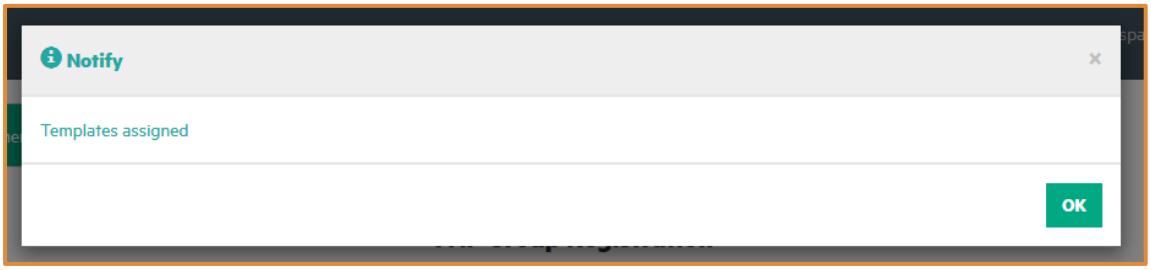


Figure 353: Notification of the addition of the VNFs

The VNFs should always be associated with at least one VNF Group. If the user is of VDC level, it is recommended to associate all the VNFs.

Chapter 4 NFV Director Users Management

4.1 My Account

My Account is a view accessible for all users by clicking **Users** in the **Management** menu in the top bar. It shows the logged user information, its role, assigned entity, profiles and operations.

In this view, the logged user can edit their own information and reset their password

4.1.1 User Data Update

To update the logged user data from **My Account**, follow these steps:

1) Click **Edit**, and update the user data:

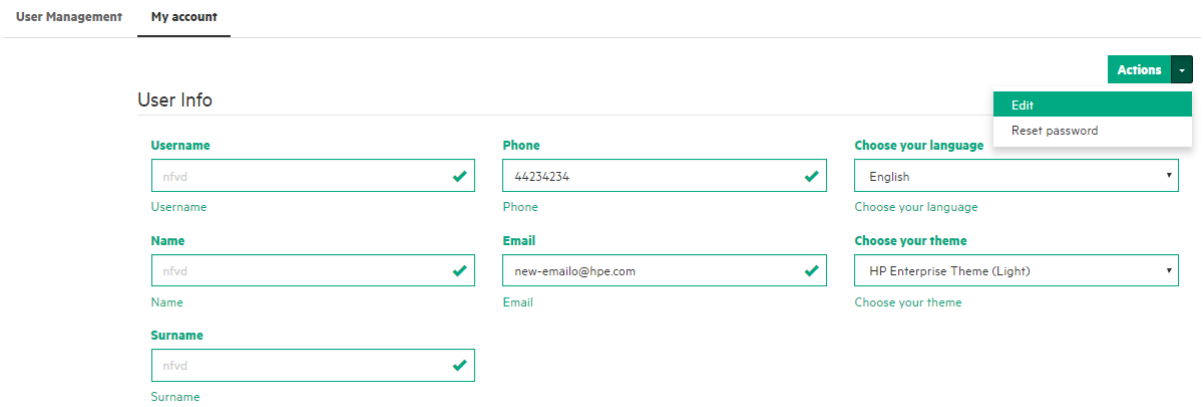


Figure 354: My Account

Only the following fields can be changed (the rest of them, `role`, `entity`, `profiles` and `operations` are read-only):

- Phone
- Email
- Language
- Theme

2) Click **Save**.

Figure 355: My Account - Save/Cancel buttons

4.1.2 User Password Reset

To reset the logged user password from **My Account**, follow these steps:

1) Click **Reset password**, and update the user data.

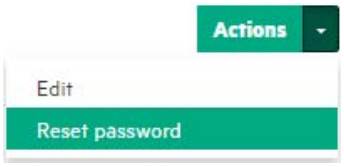


Figure 356: Resetting password

A modal window to change the password is shown.

2) Change the password.
Currently, you have two possibilities:
a) Auto-generate a new password.

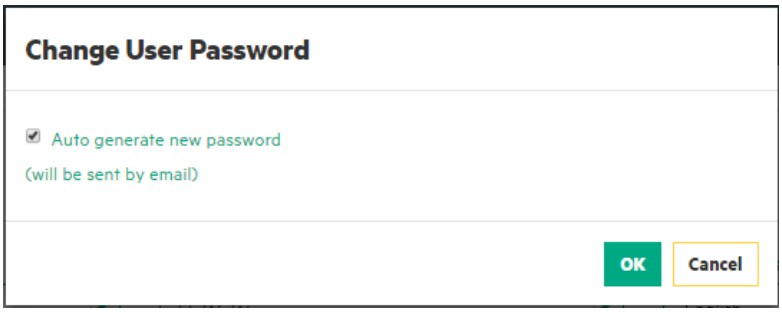


Figure 357: Changing User Password – Auto generate new password

Then a new password and SSH key pair are generated and sent to you automatically.

b) Insert your own password and public SSH key.

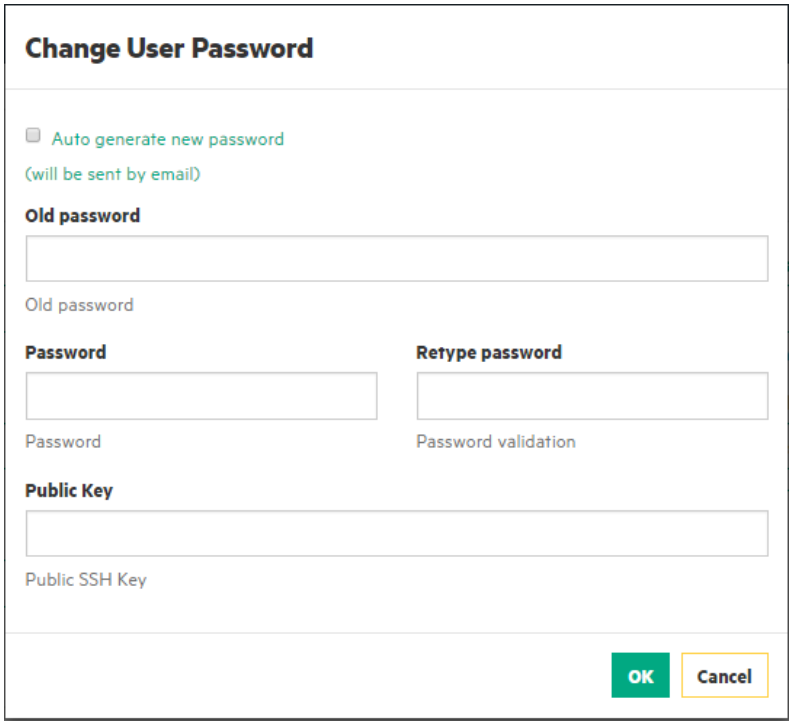


Figure 358: Changing User Password

4.2 User Registration

To create a new user, follow these steps:

1) Click **User Management** in the **Management** menu
In the appearing screen, there are two tabs, **User Management** and **My account**. In **User Management**, the users table is displayed.

2) Click the **User Management** tab, and in **Actions**, click **Create User**.

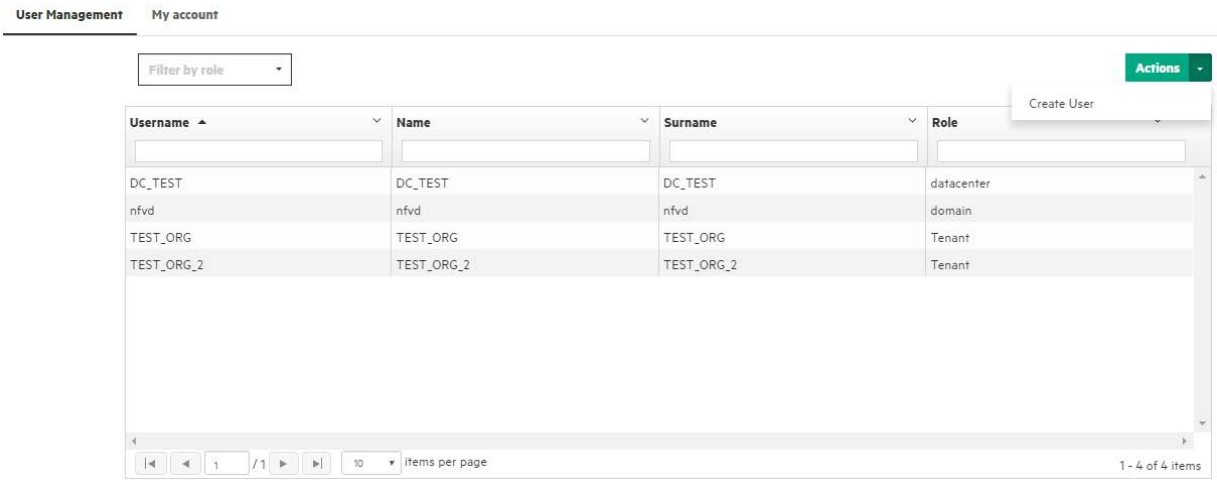


Figure 359: User Management screen

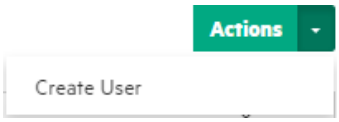


Figure 360: "Create User" action

Then a modal window will be displayed, requiring the new user data:

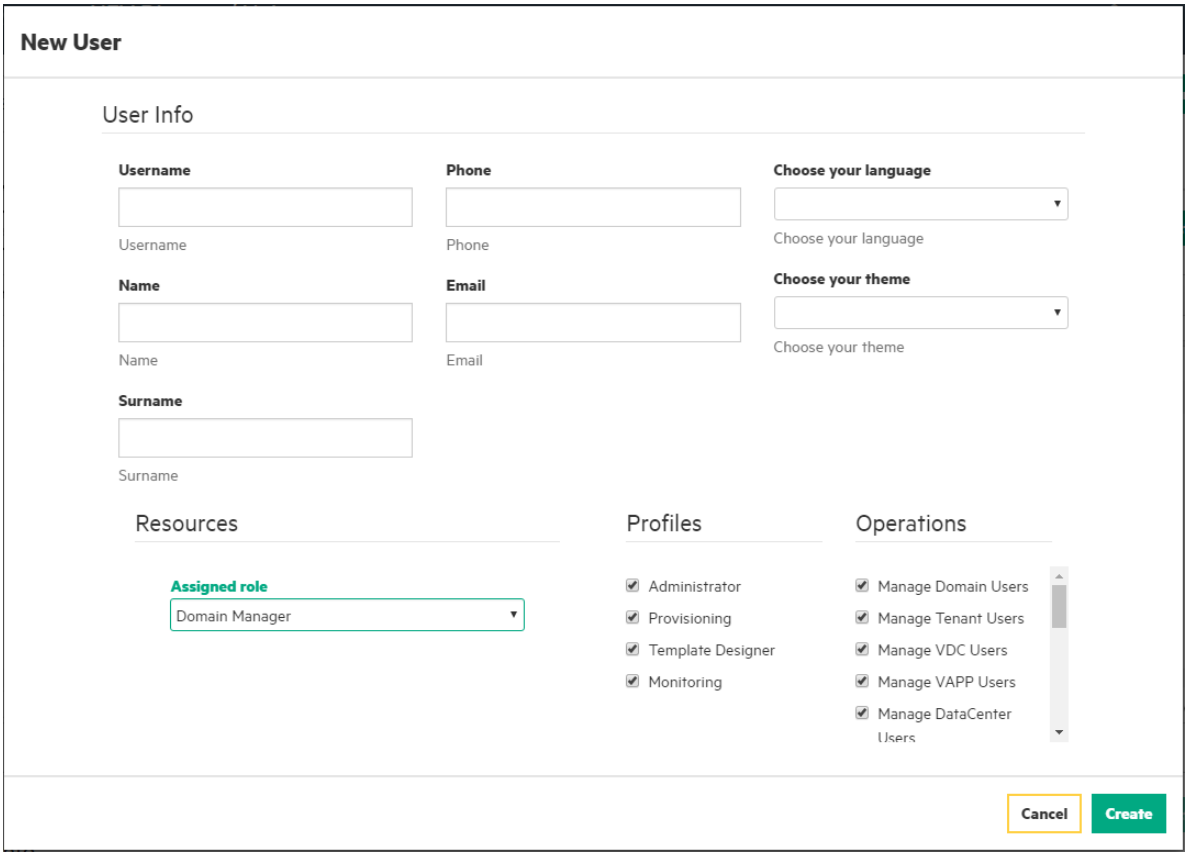


Figure 361: User Creation form

3) Insert the personal user data in the "New User" window:
   - `Username`: the string that identifies the user in the system
   - `Name`: the name of the user
   - `Surname`: the surname of the user
   - `Phone`: the phone of the user
   - `Email`: the email address where the user will receive a mail with their password
   - `Language`: default Portal language
   - `Theme`: default Portal theme

4) Select the role and entity of the user

   a) Creating a Domain Manager User

   This type of user can be created by another Domain User. You must select **Domain Manager** as "Assigned role".

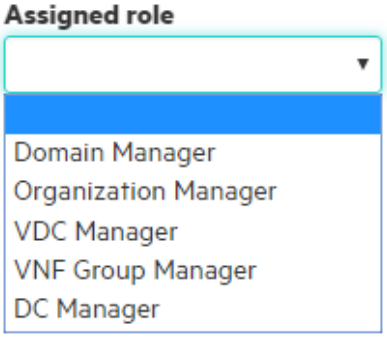


Figure 362: Possible user roles

b) Creating a Datacenter User

This type of user can be created by a Domain User or another Datacenter User. Currently, it can only manage a datacenter, so once the role is selected, the datacenter to be managed by the new user is required and mandatory.

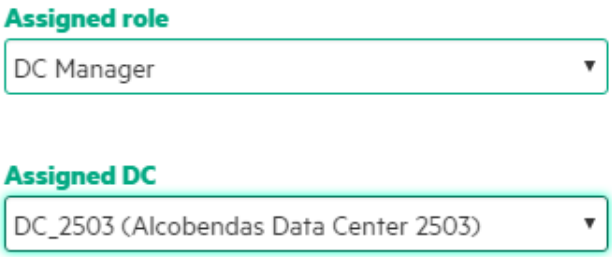


Figure 363: Assigning DC to DC manager user

If the logged user is a Datacenter User, only its own datacenter can be assigned to the new user. Otherwise, if the user is being created by a Domain User, any Domain Datacenter can be assigned to it.

c) Creating an Organization Manager User

This type of user can be created by a Domain User or another Organization User. Currently, it can only manage an organization, so once the role is selected the organization to be managed by the new user is required and mandatory.

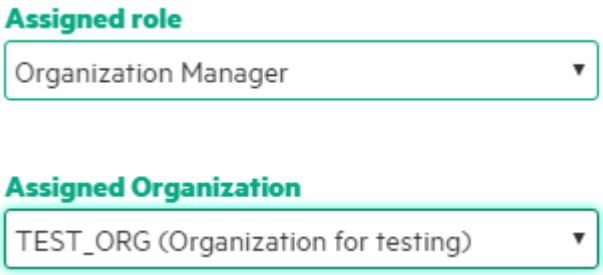


Figure 364: Assigning Organization to Organization manager user

If the logged user is an Organization User, only its own organization can be assigned to the new user. Otherwise, if the user is being created by a Domain User, any Domain Organization can be assigned to it.

d) Creating a VDC Manager User

This type of user can be created by a Domain User, an Organization User or another VDC User. Currently, it can only manage a VDC, so once the role is selected, the VDC to be managed by the new user is required and mandatory.

Figure 365: Assigning VDC to VDC manager user

If the logged user is a VDC User, only its own VDC can be assigned to the new user. Otherwise, if the user is being created by an Organization User, any Organization VDC can be assigned to it.

e) Creating a VNF Group user

This type of user can be created by a Domain User, an Organization User, a VDC user or another Group User. Currently, it can only manage a Group, so once the role is selected the Group to be managed by the new user is required and mandatory.

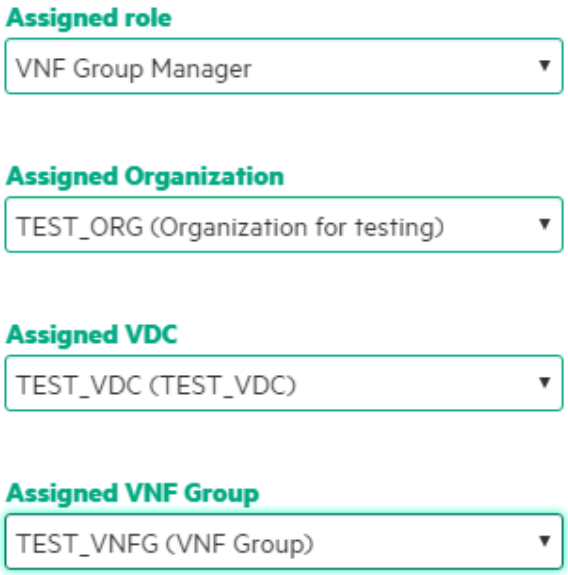


Figure 366: Assigning VNF Group to VNF Group manager user

If the logged user is a Group User, only its own Group can be assigned to the new user. Otherwise, if the user is being created by a VDC User, any VDC VNF Group can be assigned to it.

5) Select the profiles and operations of the user

When the organization role has been selected, the profiles and operations that are specific to the user role are shown.
You can select or unselect a complete profile, or several operations within a profile.

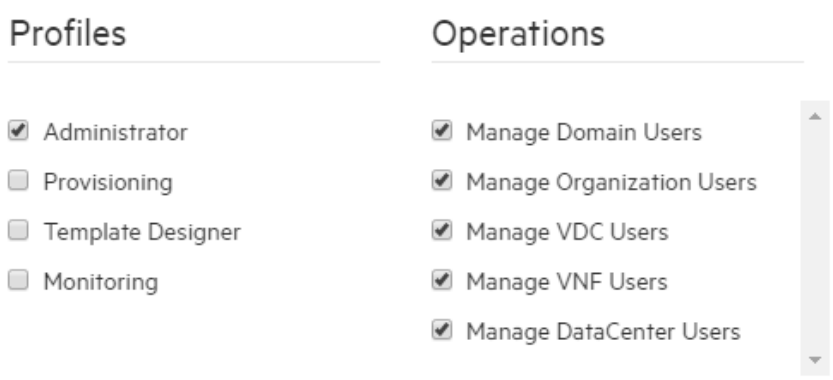


Figure 367: Selecting Profiles & Operations when creating a user

6) Click Create.

Once the user is created ,an email is sent to its email address indicating the user password (automatically generated).

4.3 User Edition

To update a user's data, follow these steps:

1) Select the user to update in the users table (User Management)

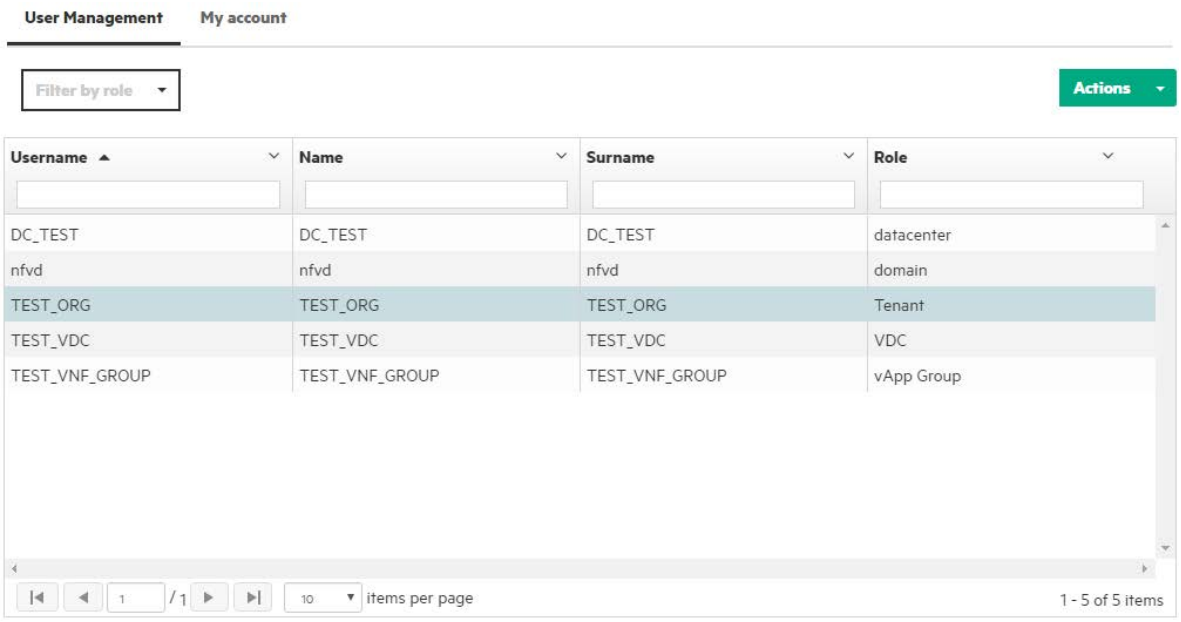


Figure 368: Users table

2) At the screen below, at the selected user info, click Edit.

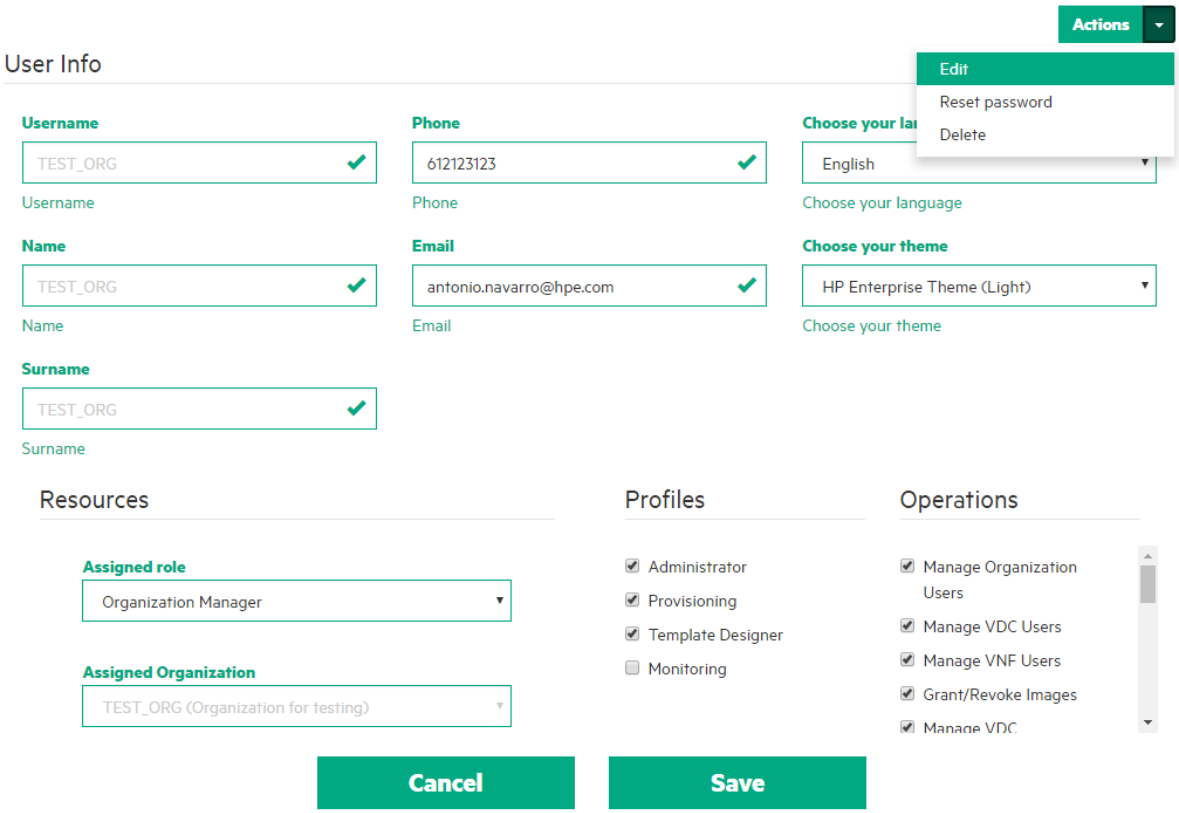


Figure 369: "Edit User" Action

The updatable fields will be enabled, so you can update them. The user updatable fields are the following:

- Phone
- Email
- Language
- Theme

The user role can be updated, but if the user has an Organization, VDC or VNF Group role, the `Assigned Organization` cannot be updated.

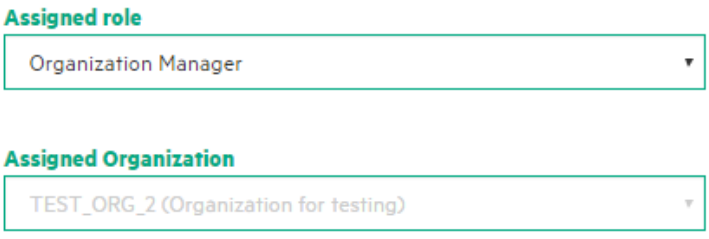


Figure 370: Fixed Organization when updating user role

The user roles and profiles can be updated, too.

4.4 Resetting Password

To reset a user's password, follow these steps:

1) Select the user to update in the users table (User Management).

2) At the screen below with the selected user info, click Reset password.

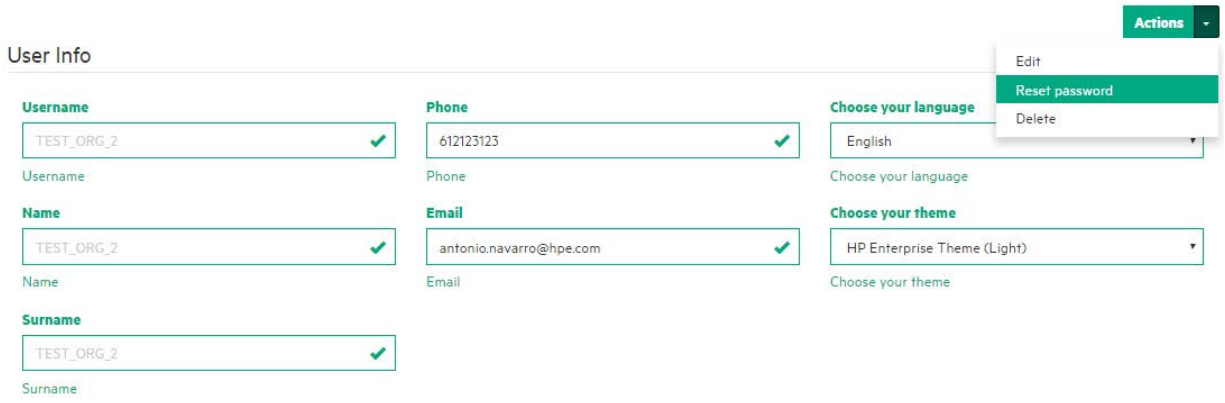


Figure 371: "Reset password" action

3) Click OK in the displayed window.

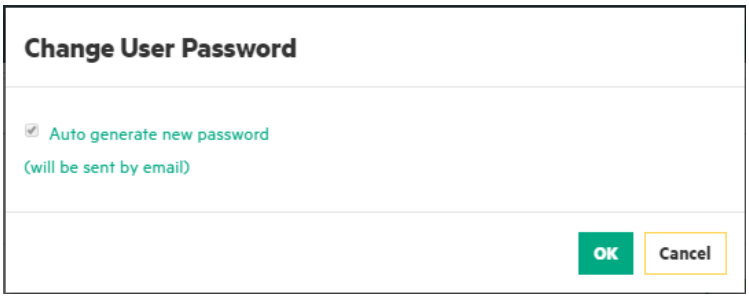


Figure 372: Change User Password - Confirmation Window

The new password will be auto-generated and sent to the user by email.

4.5 Deleting a user

For delete an existing user follow these steps:

1) Select the user to delete in the users table (User Management)

2) At the screen below, at the selected user info, click Delete.

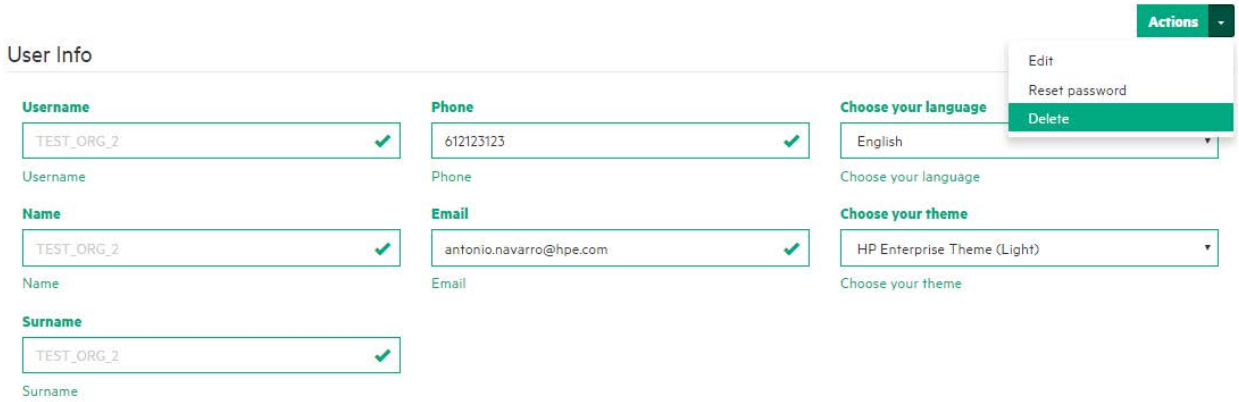


Figure 373: "Delete User" Action

3) Click Yes in the confirmation window.

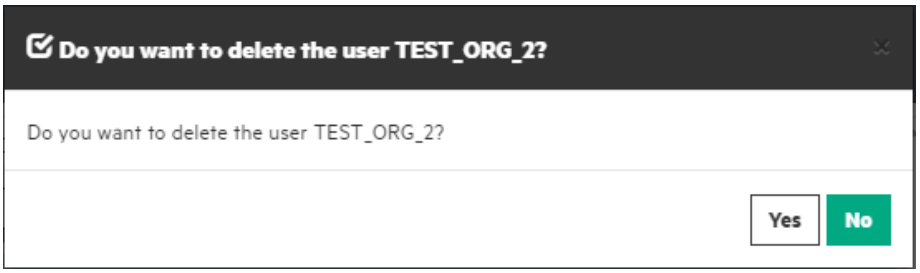


Figure 374: User Deletion - Confirmation Window

The selected user will be deleted.

Chapter 5 NFV Director Job tracking

Some actions requested from the Portal launch a process that is executed in background. That process is responsible for performing the action you requested, and is called a job.

You can see the list of jobs that have been executed by you, or by a user of a lower level.

There are two ways to access Job tracking.

1) Click **Job** in the top bar.

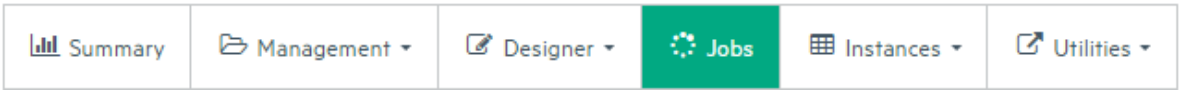


Figure 375: "Jobs" option

Then you access the Job tracking screen:

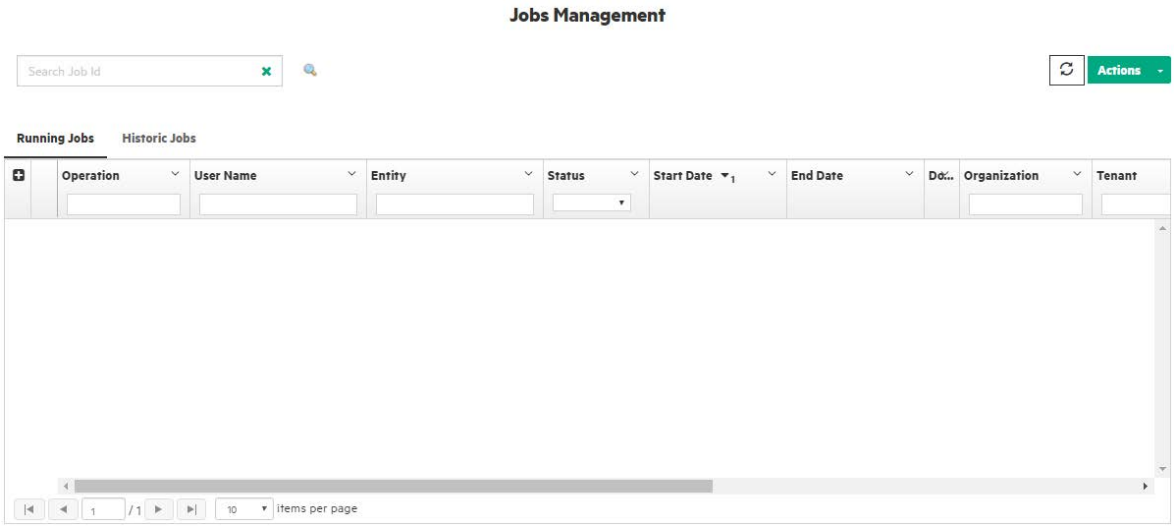


Figure 376: Jobs tracking screen

2) At **Jobs Monitor**, click the job operation link

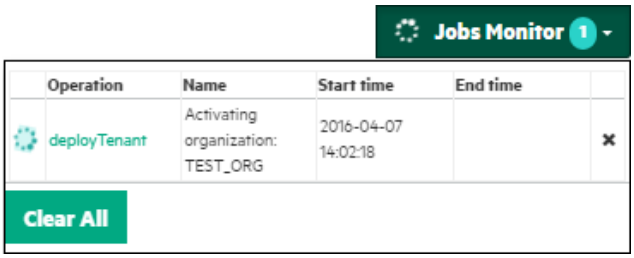


Figure 377: Running Job link in Jobs Monitor

Then you will access the Job tracking screen with the selected job filtered:

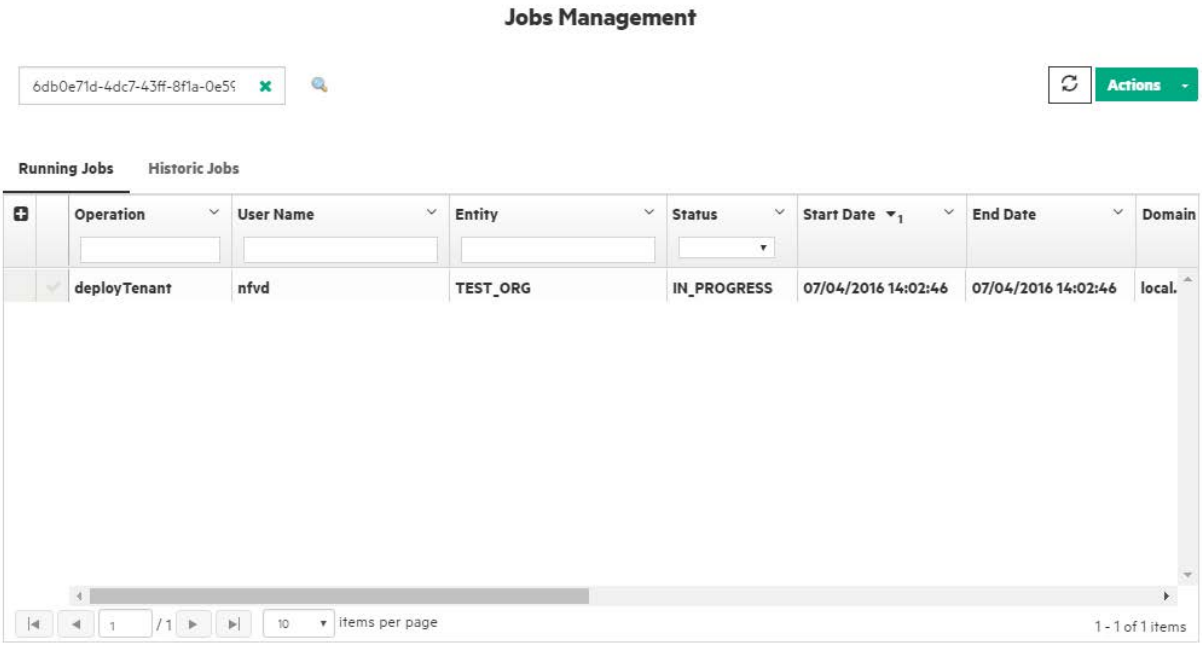


Figure 378: Jobs Management - Running Jobs

You have two tabs in Job screen:

- Running Jobs: jobs that currently are executing
- Historic Jobs: jobs that have finished

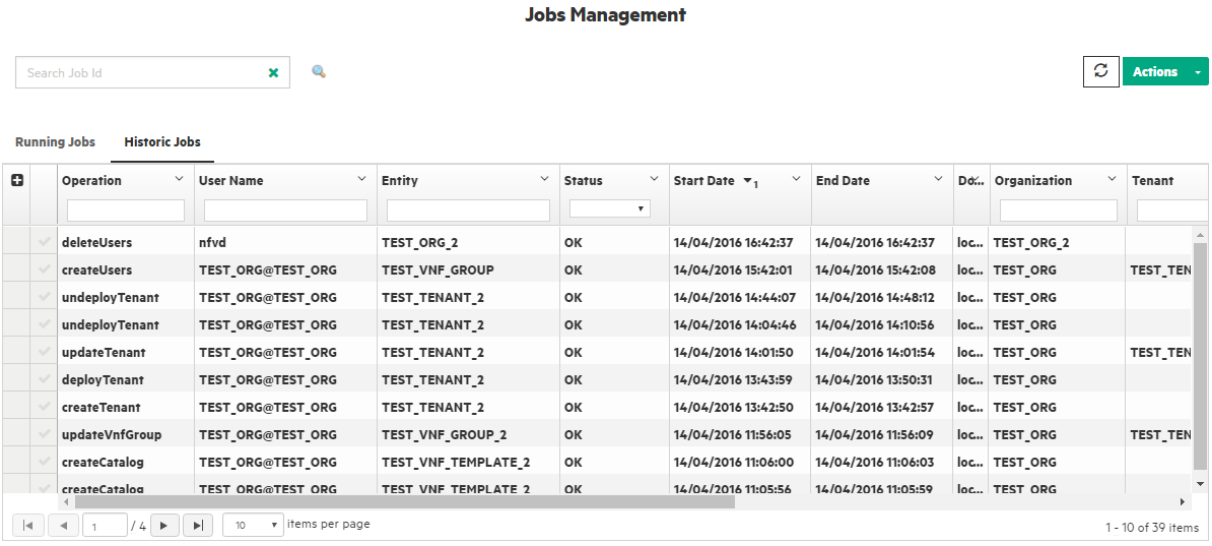


Figure 379: Jobs Management - Historic Jobs

5.1 Filtering jobs

You can look for a specific job if you know its ID (it can be recovered from the notifier once the job has been launched).

Figure 380: Filtering Job by ID

You can also filter jobs using actions:

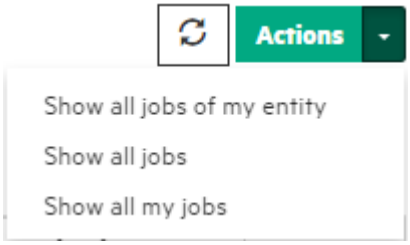


Figure 381: Filtering Jobs by entity

- Show all jobs of my entity: jobs related to your associated entity
- Show all jobs: jobs related to your associated entity and to its lower entities
- Show all my jobs: jobs launched by you

The jobs showed in the table can be sorted and filtered using the text box in the headers:

Figure 382: Filtering and Ordering Jobs table

5.2 Show a job details

To view the details of a job, select the job and all its information will be shown in a form below the jobs table.

A job can have several associated tasks related between them. If so, such tasks are shown in a GANTT diagram once the job has been selected. You can see the status of every job task, and also the time it was executed.

If the selected job is still running, you can refresh its diagram by clicking Refresh Data.

Figure 383: Job GANTT Diagram

5.3 Performing Retry/Rollback on a failed job

Failed jobs can be retried. To retry a failed job, select the failed job and click Retry. Then the failed job will be launched again.

Once a job has failed, the tasks that have been executed can be rolled back if the user does not want to retry it. To roll back a failed job, select the failed job and click on Rollback action. The all job task will be rolled back.

5.4 Aborting a running job

The execution of a running job can be aborted on the “Running Jobs” screen.

Select the job to abort and click Abort Job.

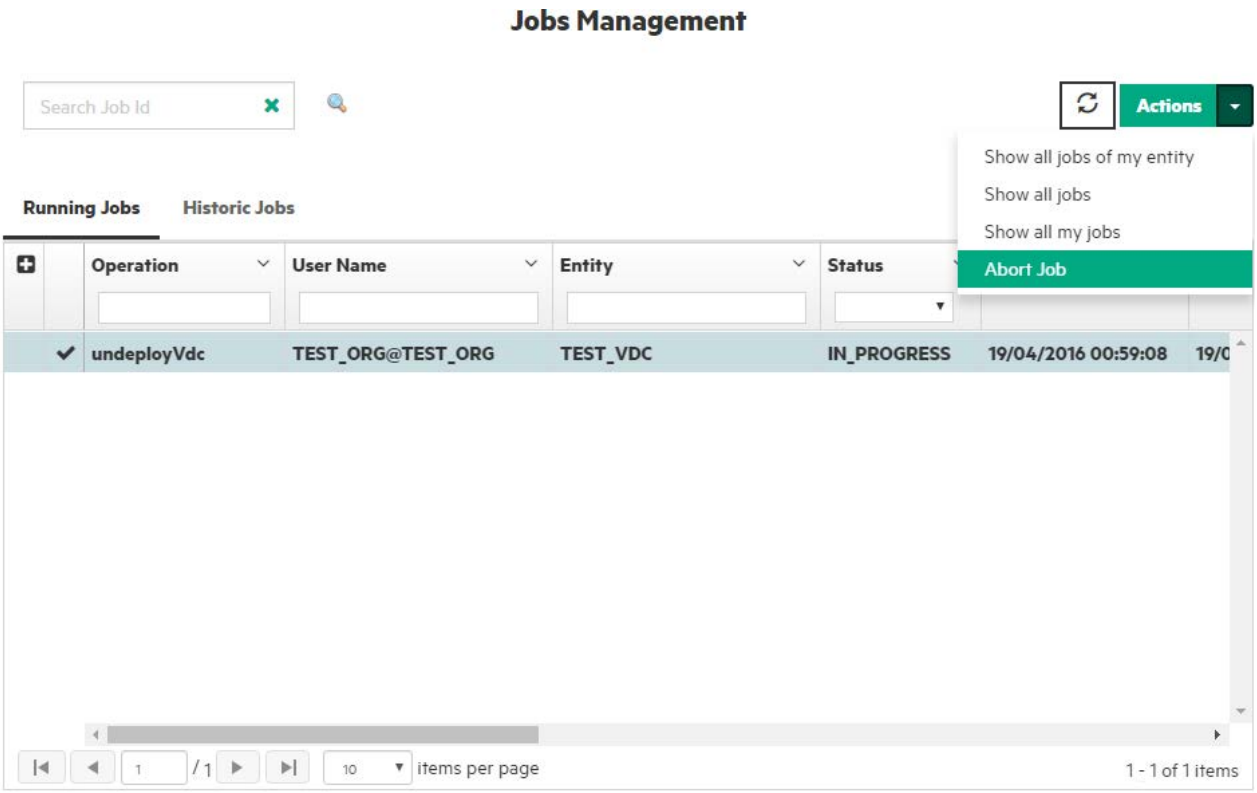


Figure 384: Aborting a running job

Chapter 6 NFV Director Images management

This chapter shows the user how to register and upload new OS images into the Images Repository. Those images will be used to deploy virtual machines.

Users with any role can manage images if their own users have the corresponding operation assigned (Manage Images).

To access Image Management, click **Images Management** in the **Management** menu:

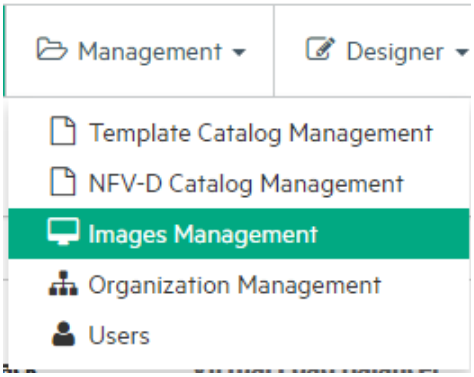


Figure 385: Image Management

The "Images Management" screen is displayed, where all the images are listed.

Figure 386: Images table

When the user selects an image, all its information will be shown in a new form below the images table:

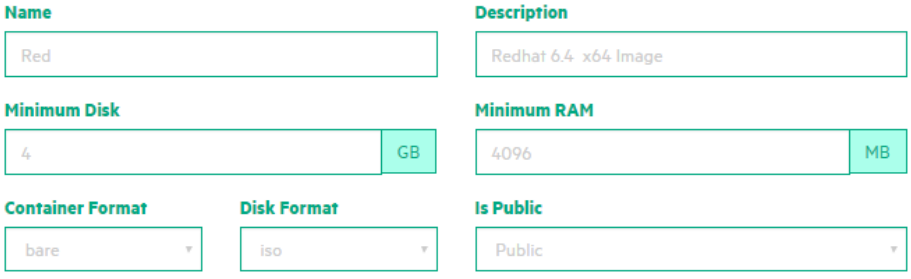


Figure 387: Images data

6.1 Registering an image

To register a new image, follow the below steps:

1) Click **Create Image**.

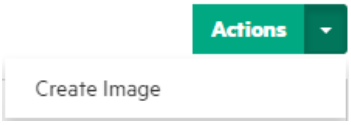


Figure 388: "Create Image" action

The registration window is displayed.

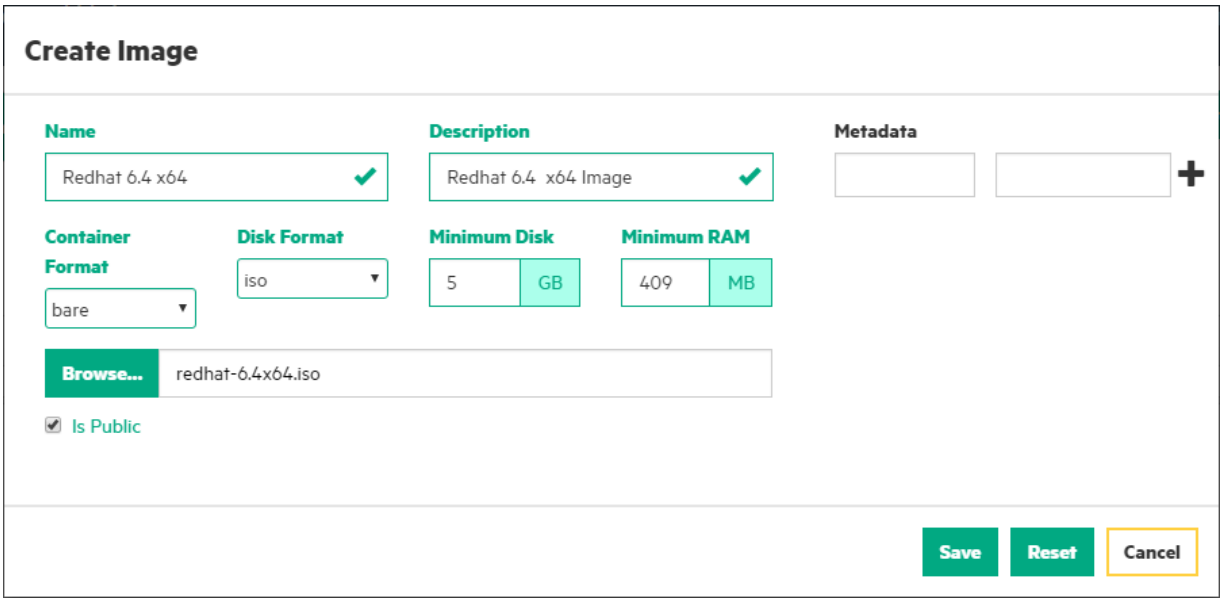


Figure 389: Create Image form

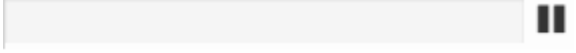
2) Insert the image data:
   - Name: unique name for the image in the system
   - Description: a string describing the image
   - Container Format
   - Disk Format
   - Minimum Disk: minimum needed available disk for deploying the image
   - Minimum RAM: minimum needed available memory RAM for deploying the image
   - Is Public: indicates the visibility of the image
   - Image File: when creating an image, you must indicate the local file that contains it, so it can be uploaded to the Images Repository from your machine

3) Click **Save**.

The image is registered and the uploading begins. The image will be unavailable for deployment until it will be completely uploaded on the Images Repository.

When the uploading starts, a progress bar is shown in the status column for that image.

The upload can be paused using the icon in image status field:



The upload can be resumed, too, after the upload is paused. In this case, the user will select the image file again. If a different file is selected, an error message is displayed.

Figure 390: "Continue Upload" option

Once the image is uploaded, a process is launched in the Repository to check if the uploading was correctly executed. This way, any error can be detected.

Figure 391: Uploaded Image status

When the process has checked that the uploading has been uploaded correctly the image status change to "Active".

Figure 392: Active Image status

6.2 Editing an image

To upload an existing image, follow the steps below:

1) Select the image you need to change.

2) Click Edit Image.

   The Edit Image windows in displayed.

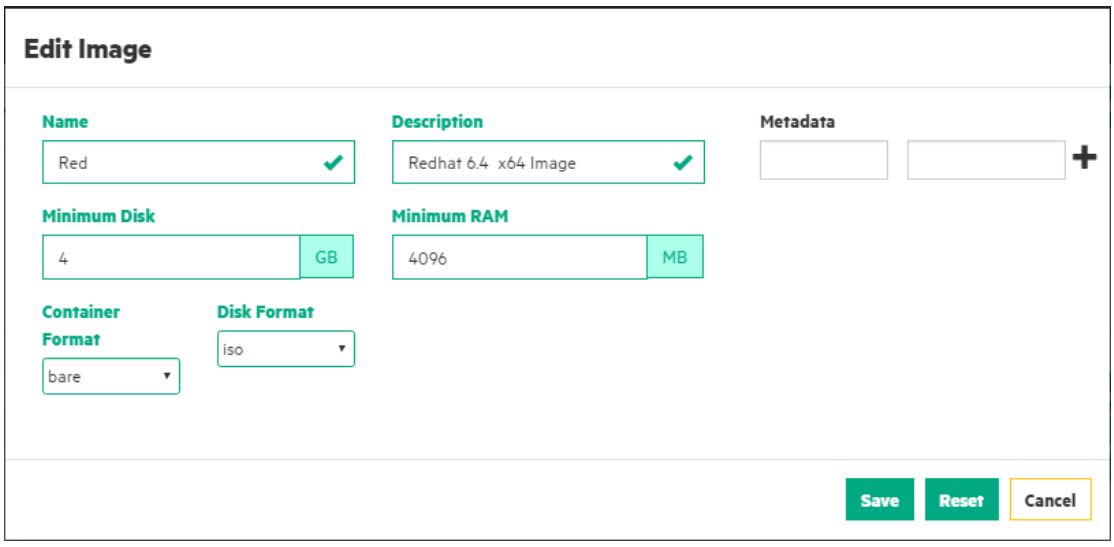


Figure 393: Image Edition form

3) Click + to add new row.
4) Perform the needed changes and click Save.
   All the image fields can be changed, including metadata. However, the image file cannot be uploaded again.

6.3 Deleting an image

To delete an existing image, follow the steps below:

1) Select the image you need to delete.

2) Click **Delete Image**. A confirmation window is displayed.

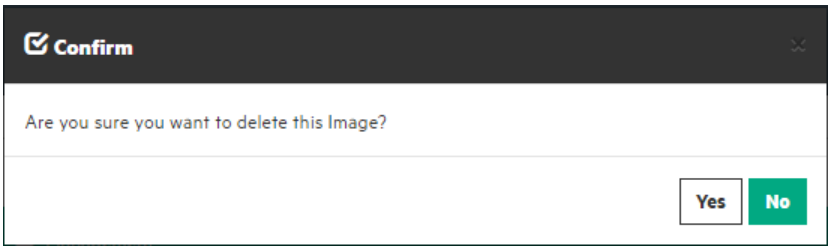


Figure 394: Deleting an image - Confirmation window

3) Click **Yes**, and the image will be deleted.

6.4 Image visibility

Image visibility determines which users can use the image. There are two types of visibility:

- Private: the image is only available for its user.
- Public: depending on the image owner:
  - If the image belongs to a Domain, it can be used by every entity.
  - If the image belongs to a different entity (Organization, VDC or Group), it can be used by the Domain, and every entity in the owner Organization.

The image visibility is established by the owner at registration.

Once the image has been created, its visibility can be changed following the steps below:

1) Select the image in the images table and click **Change Visibility**.

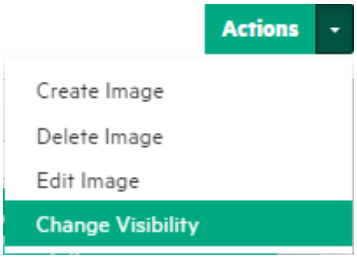


Figure 395: Change visibility action

A confirmation window is shown.

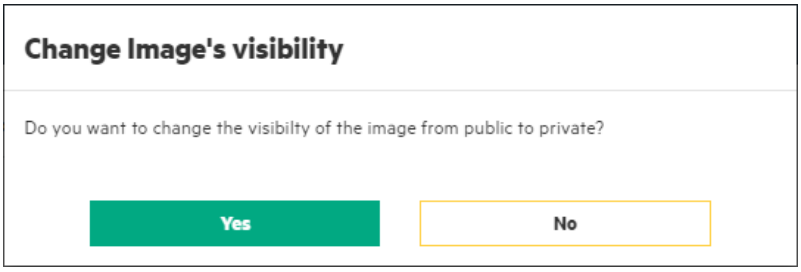


Figure 396: Changing Image from public to private - Confirmation Window

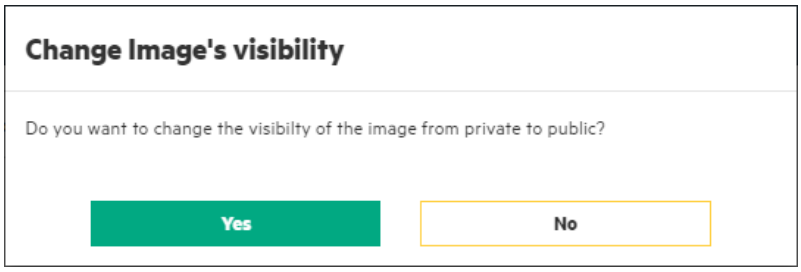


Figure 397: Changing Image from private to public - Confirmation Window

2) Click Yes. The visibility will be changed and the images table is refreshed.

6.5 Image ownership

First, an image belongs to the entity of the user that registered it. However, its ownership can be changed:

- If your entity is the image owner
- If the image belongs to an entity that depends on your entity (all entities of a domain, Groups of a VDC, Groups and VDCs of an Organization)

Image ownership can be changed by the owner.

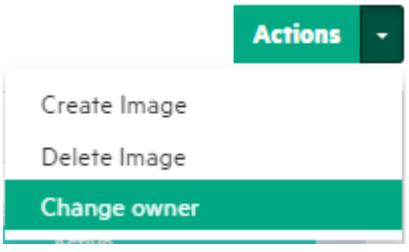


Figure 398: Change owner action

A user can get the ownership of an image if it belongs to an entity of lower level.

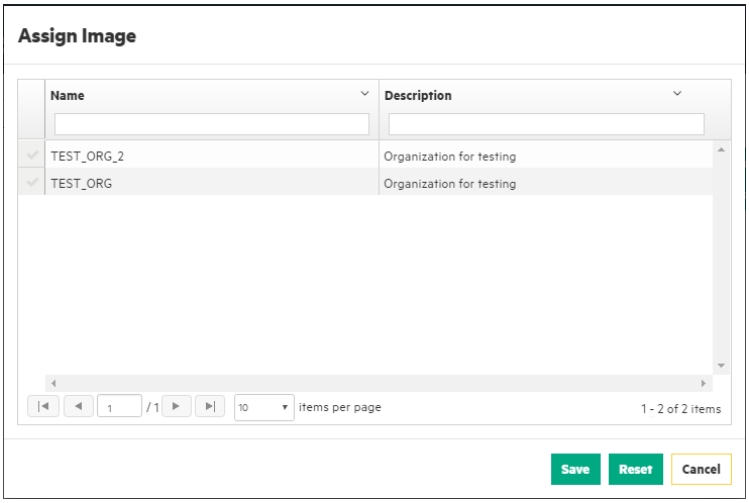


Figure 399: Assigning Image

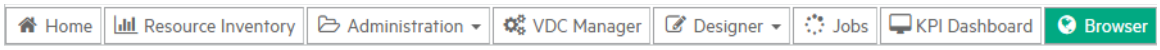
Chapter 7 NFV Director Browser

7.1.1 Introduction

The NFVD Browser is the tool that allows the user to browse and edit all templates, instances and resources. It also provides a graph view to show the hierarchy of the components.

For each user, the browser will only present the template/instance/resource assigned to the user.

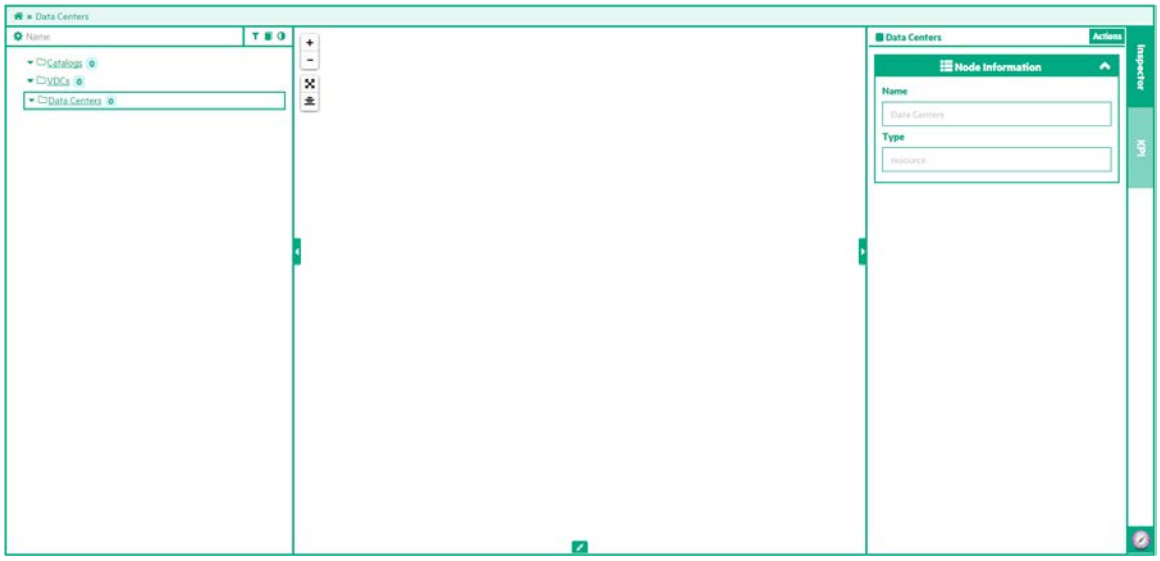
To access the NFVD Browser, log in the NVFD Director portal and enter the NFVDv4 workspace. For all types of users, there is a menu item, Browser, to access the NFVD Browser view.



7.1.2 Screens of the NFVD Browser

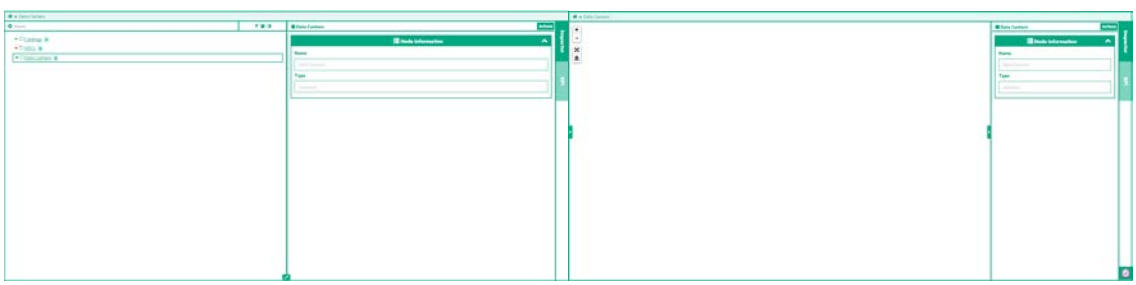
7.1.2.1 First Screen of the Browser

Once the user has entered the Browser view, you are going to see a screen like the below one:



In this window, we can differentiate three main parts. Besides the menu of the platform, on the left of the window, we can see a tree view with all visual able elements. In this tree, the user will find components/artifacts such as VNF template/instance, VDC instances, Data Centers and so on. In the middle, there is a graph area that will used to present the hierarchy of components. On the right, there are the inspector and KPI frames. This area is used to present the attributes of a component/artifact and the KPI values fed by the assurance module.

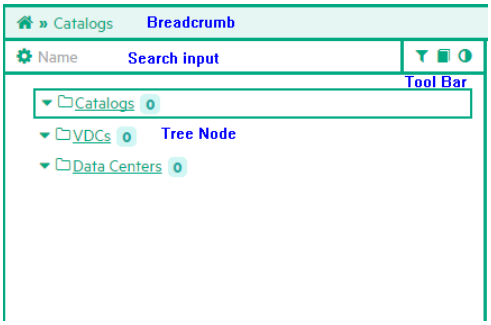
The areas can be hidden by clicking the hide/show buttons.



7.1.2.2 Navigate Tree

The Navigate Tree is the place where the user will find all elements. The full area is composed of:

- Breadcrumb
- Search input area
- Toolbar
- Tree Nodes



7.1.2.2.1 Tree Nodes

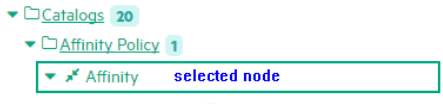
The user can access all components from the Navigator tree (all artifacts of catalog/template, instance/VDC can be accessed from the graph view; few types of artifacts of resource/Data center can be accessed from the tree, such as Server).

There are two types of nodes:

- Element Node – the nodes are linked to the components and artifacts. Each node has an icon on the left, which stands for different type and a label to show the name of the element. For the artifacts, the label is in *Italic*.
- Group Node – in the sub-tree, the element nodes are grouped by their types, the group nodes show the type name in the label and the number of element nodes on the right. It has a dedicated icon on the left.

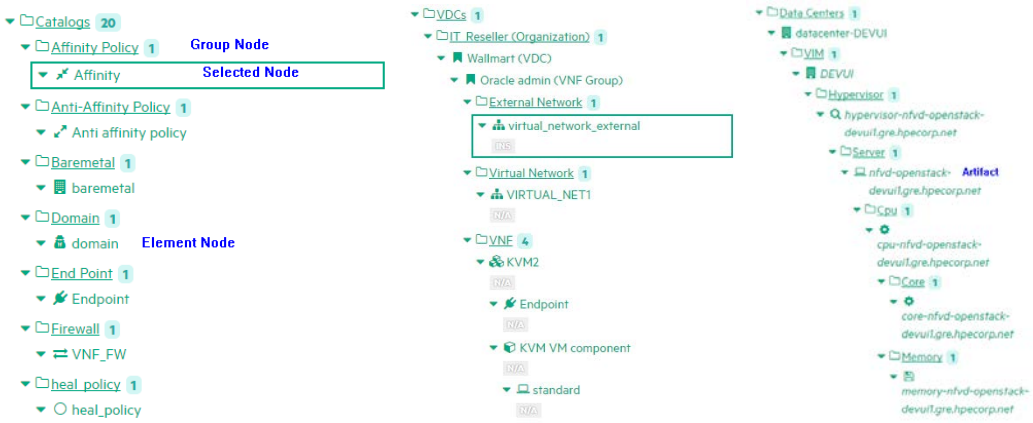
Selected Node

If a node is selected, it will be highlighted by a rectangle border. The content of the inspector is always synchronized with selected node. In browse mode, the selected node will change as your mouse pointer moves in the tree, and in the edit mode the selected node only changes by clicking in the tree. (Refer to tool bar of Navigate tree).



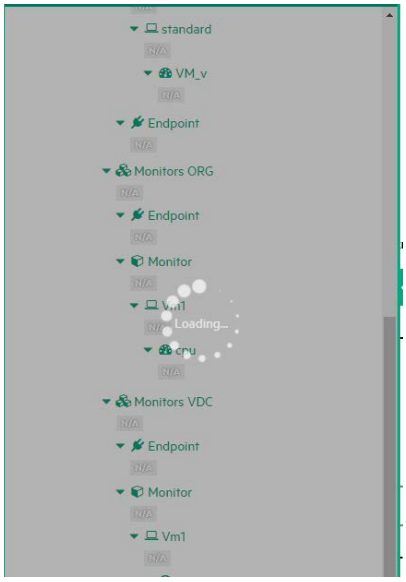
Data Loading

In the beginning, there are only three root group nodes in the tree: Catalogs (templates), VDCs (instance) and Data centers (resource). There is no sub element in the tree. All data are loaded at the first time the user clicks the parent node or double-clicks the node for refresh.



After loading, sub-nodes will be added into the tree.

To load data, it will take time to query data and build the tree. During loading, the Navigate tree frame will be blocked by a spinner frame.



Due to the amount of data, not all data (attributes) are loaded. When you click the element node, it may launch a second query to fetch the full object.

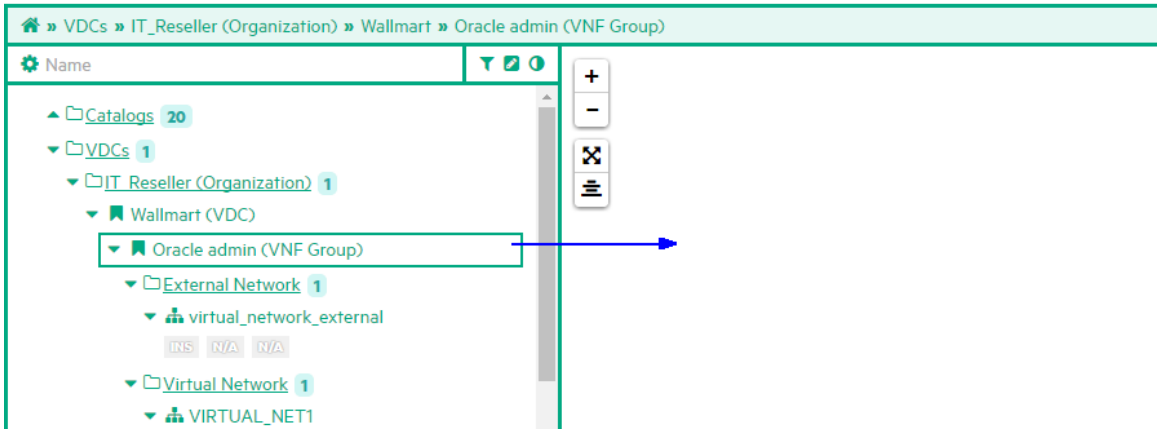
Refresh Data

There is no **Refresh All** function in this view. You can refresh data by double-clicking the nodes. The 'refresh' action will clear and reload the data of the node. The sub-nodes are rebuilt as well.

Status of instances

For all instance components, there are 0 to 3 labels to show their status. Status informatuion is collected from the Fullfill module and the Assurance module. The status will be loaded with the node or from the toolbar. (Refer to the toolbar of the Navigate tree).

Launch VDC Manger



If you drag and drop the VNF group instance into the graph area, it will jump to the VDC manager with the dropped group.

7.1.2.2.2 Breadcrumb

The breadcrumb is used to show the full hierarchy path of the selected node. You may click the path to change the selected node.

7.1.2.2.3 Toolbar

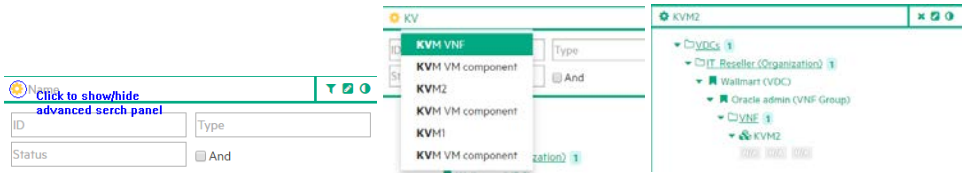
There are tree buttons in the toolbar: 

- Enable/Disable filter – if the filter is active, and the search context is not empty, the tree will filter the nodes. (Refer to Tree Filter)
- Switch Tree working mode – there are two modes of the tree: Browse mode and Edit mode. In Browse mode, the selected node will change to the node where the mouse is, and all attributes are read only. In Edit mode, the selected node can only be changed by clicking the tree node, and the attributes will become editable in the inspector. Note that not all attributes are editable, it depends on the status of the instance, user permissions, restrictions, and so on.
- Status setting – Set it to show the status of instances. 

. If you want show the status, select the check box. The refresh button on the top right will launch queries to update all status information of the instance nodes in the current tree.

7.1.2.2.4 Search Input Area

The search input panel is the place to input the conditions for the filter function.



By default, it only shows the input for Name filter. To show the advanced panel, click the icon on the left.

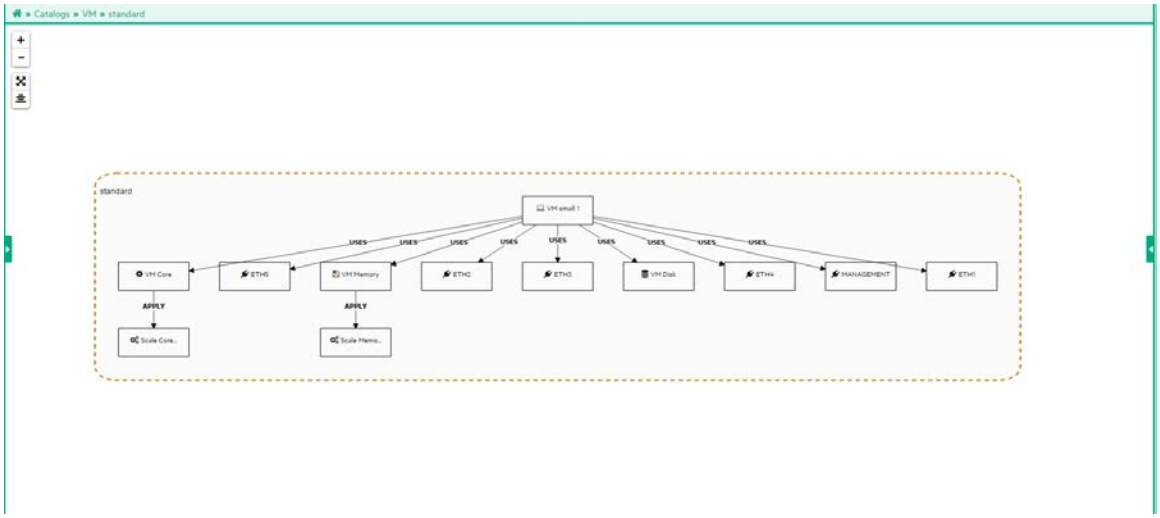
Input the `Name`, `ID`, `Type` or `Status` you want to search against (case sensitive), and click the filter button. The results will be displayed in a new tree.

To update the criteria or switch back to the full tree, click the remove filter button in the toolbar.

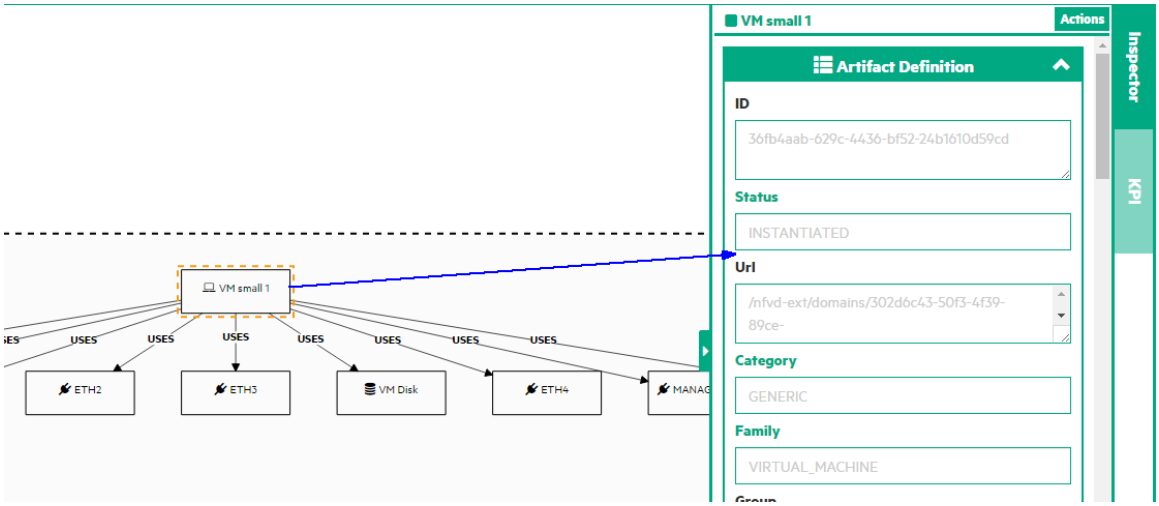
The criteria are combined by an `OR` logic by default. Select the `AND` check box in the advance panel to change it to `AND`.

7.1.2.3 Graph Area

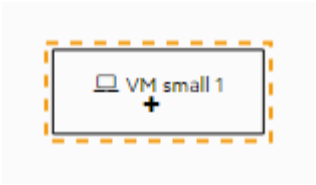
This area is used to show the hierarchy of components. It shows all sub-components and artifacts, and also their relationships.



Select the artifact in the graph. All of its attributes will be shown in the inspector.



Double-click the node to collapse/expand the node.



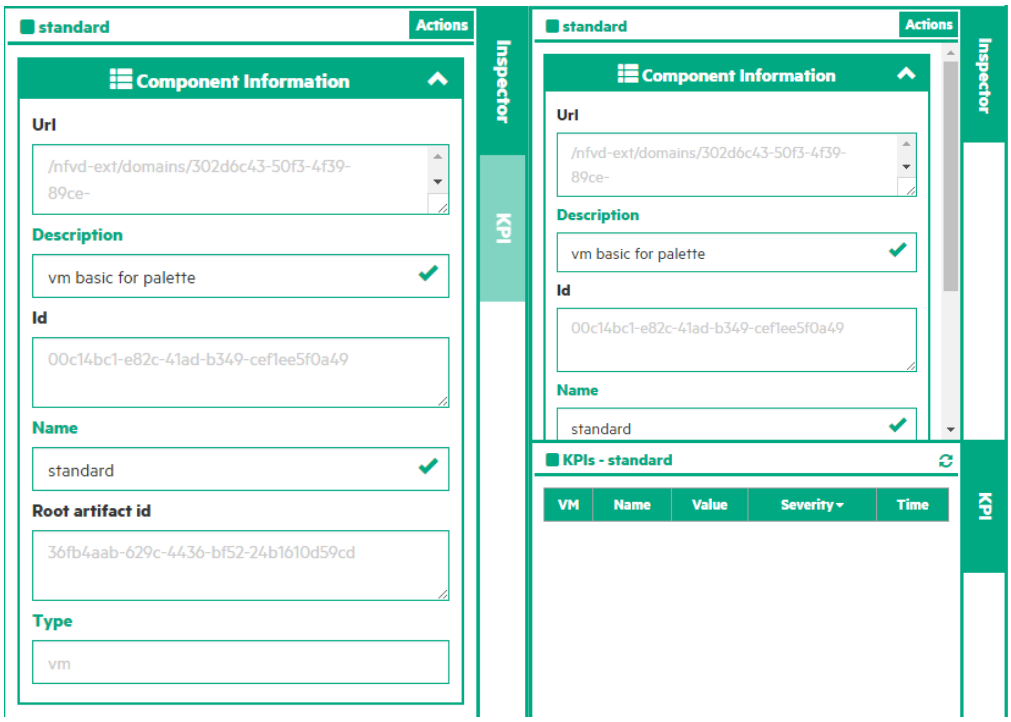
In the graph view, user can do the following:

- Move the node's position with the mouse
- Zoom in/out the view using the tool button or scrolling with the mouse
- Auto layout or center the view using the tool button

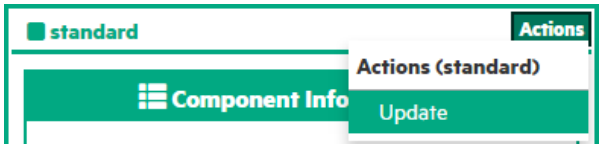
7.1.2.4 Inspector and KPI Area

This area is composed by two tab frames, inspector and KPI.

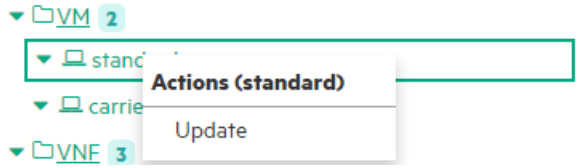
You can double-click the tab header to switch the layout of the frames between cascade and vertical view.



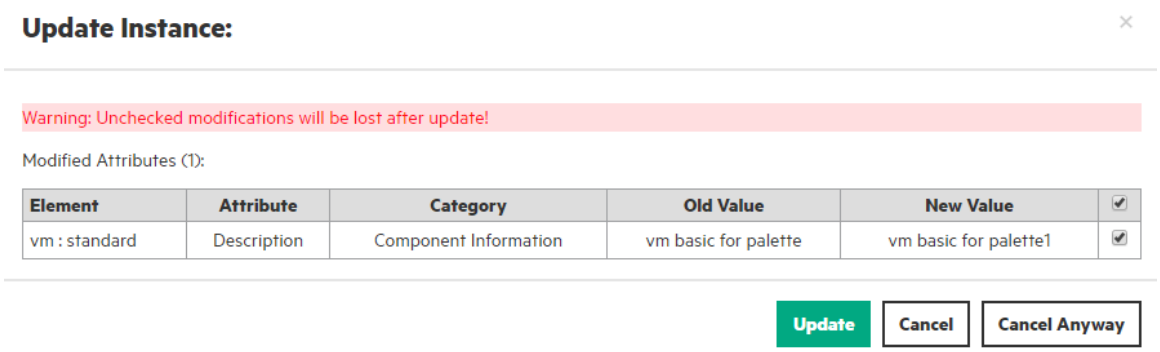
The inspector always shows the attributes of the selected node (in tree or graph). In the edit mode, the user can edit the value of the attributes in the inspector. After modification, use the Actions button to commit the changes.



There is a context menu in the tree to commit data as well.



If the user switches to selecting another node without committing the modifications, the following dialog box will pop up:



Click **Update** to commit the updates and switch to the selected node.

Click **Cancel** to cancel the switch of selected node. (Updates not committed)

Click **Cancel Anyway** to switch the selected node without committing the updates. (Updates will be lost).

Note: If the update failed, user may refresh the data manually to re-synchronize the data.

KPIs

The KPI panel shows the values of the selected node. The KPI values are collected from the Assurance module. If the values are not loaded by default, click the refresh button to get and refresh them.

Abbreviations

Abbreviation	Definition
VM	Virtual Machine; virtualized computation environment that behaves very much like a physical computer/server
VNF	Virtual Network Function; the "application" that provides the functionality currently provided by devices
NS	Network Service; a composition of network functions (VNF or PNF) and defined by its functional and behavioral specification
NFV	Network Function Virtualization; the approach to building telecom services using virtualization approaches
VNFC	VNF Component; each VNF is composed of one or more components, often mapping to a VM
MANO	Management and Orchestration; addressing the functionality required to deal with the new abstractions; consists of NFVO, VNFM and VIM
NFVO	NFV Orchestrator; In charge of the orchestration and management of NFV Infrastructure and software resources, and realizing NS on NFVI.
VNFM	VNF Manager; responsible for VNF lifecycle management (such as Instantiation, update, query, scaling, termination). Can be implemented as part of the NFVO or supplied by the VNF provider.
VIM	Virtualized Infrastructure Manager; think OpenStack or Cloud OS
NFVI	NFV Infrastructure; the totality of all hardware and software components which build up the environment in which VNFs are deployed, managed and executed
EMS	Element Management System; performs the typical management functionality for one or several VNFs.
PNF	Physical Network Function; think today's devices.
CPU	Central Processing Unit; device in the compute node that provide the primary container interface
NF	Network Function; functional block within a network infrastructure that has well-defined external interfaces and well defined functional behavior
NIC	Network Interface Controller; device in a compute node that provides physical interface with the infrastructure network
SLA	Service Level Agreement; negotiated agreement between two or more parties, recording a common understanding about the service and/or service behavior.
CPE	Customer Premises Equipment
ETSI	European Telecoms Standards Institute
HA	High Availability
SDN	Software Defined Network
HPSA	HPE Service Activator
UCA EBC	Unified Correlation Analyzer for Event Based Correlation
JSON	JavaScript Object Notation
XML	Extensible Markup Language
API	Application Programmatic Interface
DNS	Domain Name System
DHCP	Dynamic Host Configuration Protocol
IaaS	Infrastructure-as-a-Service