VCF with NetApp AFF Arrays

NetApp Solutions

NetApp
July 31, 2024

Table of Contents

VMware Cloud Foundation (VCF) is an integrated software defined data center (SDDC) platform that provides a complete stack of software-defined infrastructure for running enterprise applications in a hybrid cloud environment. It combines compute, storage, networking, and management capabilities into a unified platform, offering a consistent operational experience across private and public clouds.

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VMware Cloud Foundation with NetApp AFF Arrays

This document provides information on storage options available for VMware Cloud Foundation using the NetApp All-Flash AFF storage system. Supported storage options are covered with specific instruction for creating workload domains with NFS and vVol datastores as principal storage as well as a range of supplemental storage options.

Use Cases

Use cases covered in this documentation:

- Storage options for customers seeking uniform environments across both private and public clouds.
- Automated solution for deploying virtual infrastructure for workload domains.
- Scalable storage solution tailored to meet evolving needs, even when not aligned directly with compute resource requirements.
- Deploy VCF VI Workload Domains using ONTAP as principal storage.
- Deploy supplemental storage to VI Workload Domains using ONTAP Tools for VMware vSphere.

Audience

This solution is intended for the following people:

- Solution architects looking for more flexible storage options for VMware environments that are designed to maximize TCO.
- Solution architects looking for VCF storage options that provide data protection and disaster recovery options with the major cloud providers.
- Storage administrators wanting to understand how to configure VCF with principal and supplemental storage.

Technology Overview

The VCF with NetApp AFF solution is comprised of the following major components:

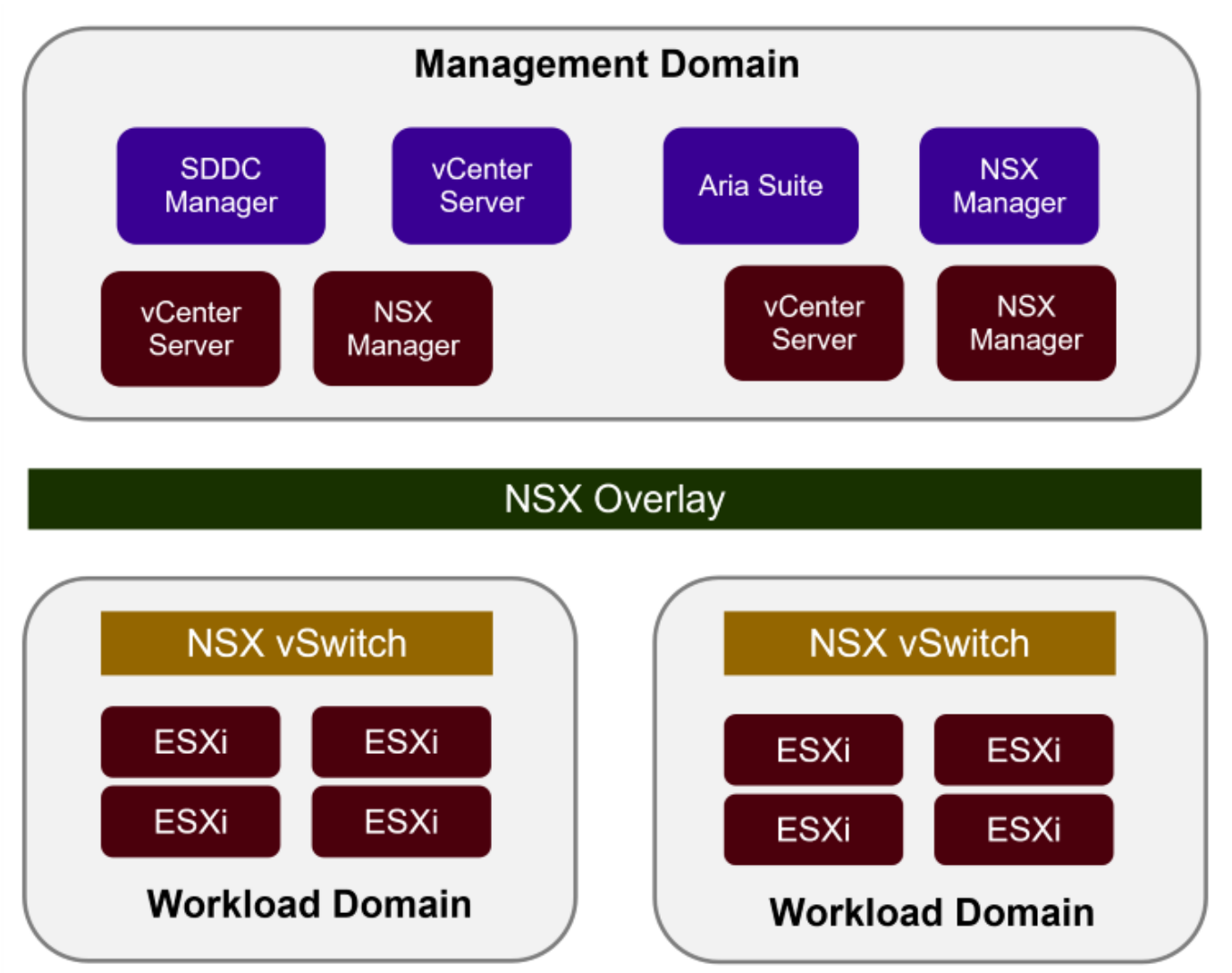
VMware Cloud Foundation

VMware Cloud Foundation extends VMware's vSphere hypervisor offerings by combining key components such as SDDC Manager, vSphere, vSAN, NSX, and VMware Aria Suite to create a virtualized datacenter.

The VCF solution supports both native Kubernetes and virtual machine-based workloads. Key services such as VMware vSphere, VMware vSAN, VMware NSX-T Data Center, and VMware vRealize Cloud Management are integral components of the VCF package. When combined, these services establish a software-defined

infrastructure capable of efficiently managing compute, storage, networking, security, and cloud management.

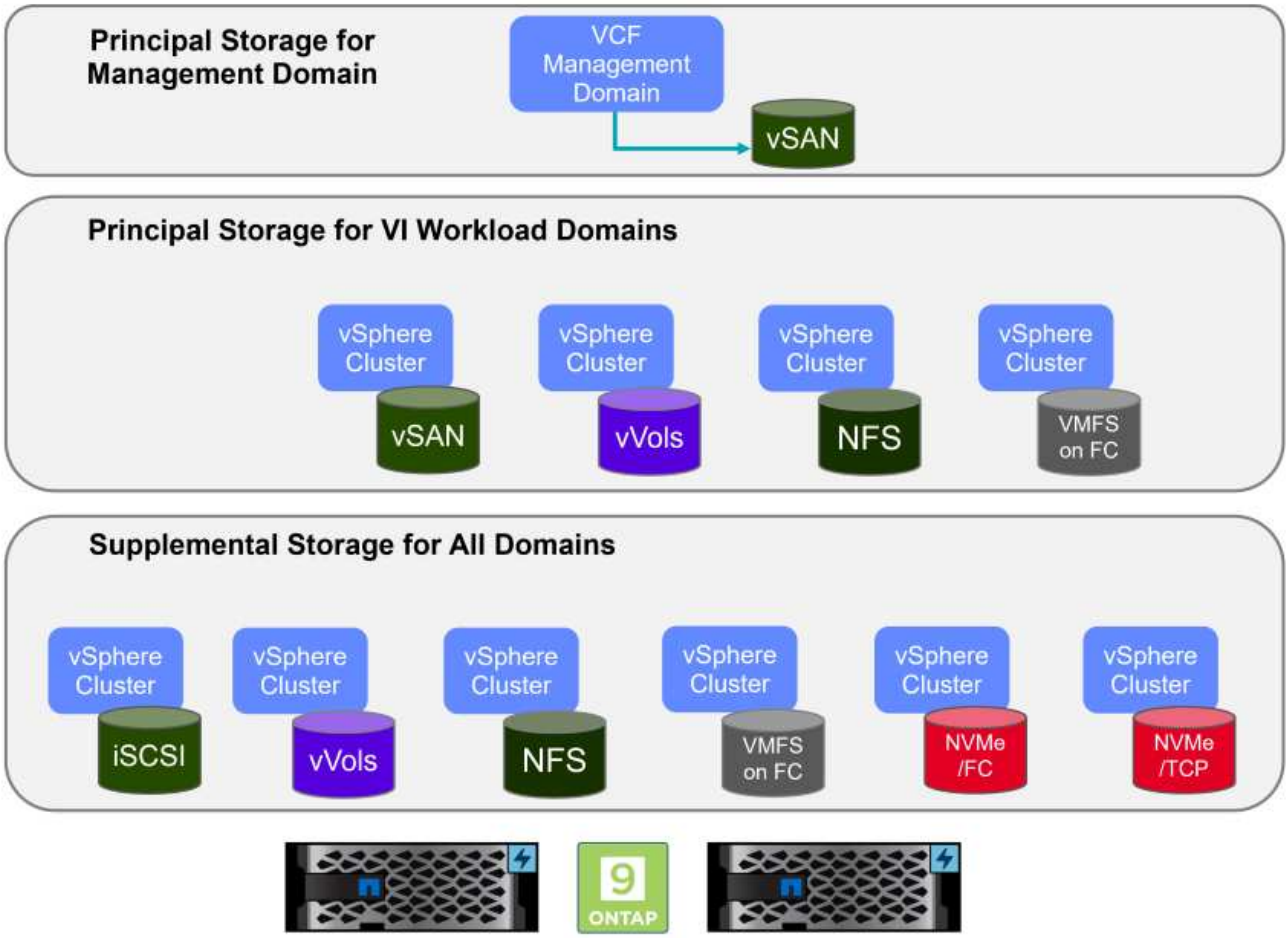
VCF is comprised of a single management domain and up to 24 VI Workload Domains that each represent a unit of application-ready infrastructure. A workload domain is comprised of one or more vSphere clusters managed by a single vCenter instance.



For more information on VCF architecture and planning, refer to Architecture Models and Workload Domain Types in VMware Cloud Foundation.

VCF Storage Options

VMware divides storage options for VCF into **principal** and **supplemental** storage. The VCF Management Domain must use vSAN as its principal storage. However, there are many supplemental storage options for the Management Domain and both principal and supplemental storage options available for VI Workload Domains.



Principal Storage for Workload Domains
Principal Storage refers to any type of storage that can be directly connected to a VI Workload Domain during the setup process within SDDC Manager. Principal storage is the first datastore configured for a Workload Domain and includes vSAN, vVols (VMFS), NFS and VMFS on Fibre Channel.

Supplemental Storage for Management and Workload Domains
Supplemental storage is the storage type that can be added to the management or workload domains at any time after the cluster has been created. Supplemental storage represents the widest range of supported storage options, all of which are supported on NetApp AFF arrays.

Additional documentation resources for VMware Cloud Foundation:
* VMware Cloud Foundation Documentation
* Supported Storage Types for VMware Cloud Foundation
* Managing Storage in VMware Cloud Foundation

NetApp All-Flash Storage Arrays

NetApp AFF (All Flash FAS) arrays are high-performance storage solutions designed to leverage the speed and efficiency of flash technology. AFF arrays incorporate integrated data management features such as snapshot-based backups, replication, thin provisioning, and data protection capabilities.

NetApp AFF arrays utilize the ONTAP storage operating system, offering comprehensive storage protocol support for all storage options compatible with VCF, all within a unified architecture.

NetApp AFF storage arrays are available in the highest performing A-Series and a QLC flash-based C-Series. Both series use NVMe flash drives.

For more information on NetApp AFF A-Series storage arrays see the NetApp AFF A-Series landing page.

For more information on NetApp C-Series storage arrays see the NetApp AFF C-Series landing page.

NetApp ONTAP Tools for VMware vSphere

ONTAP Tools for VMware vSphere (OTV) allows administrators to manage NetApp storage directly from within the vSphere Client. ONTAP Tools allows you to deploy and manage datastores, as well as provision vVol datastores.

ONTAP Tools allows mapping of datastores to storage capability profiles which determine a set of storage system attributes. This allows the creation of datastores with specific attributes such as storage performance and QoS.

ONTAP Tools also includes a **VMware vSphere APIs for Storage Awareness (VASA) Provider** for ONTAP storage systems which enables the provisioning of VMware Virtual Volumes (vVols) datastores, creation and use of storage capability profiles, compliance verification, and performance monitoring.

For more information on NetApp ONTAP tools see the ONTAP tools for VMware vSphere Documentation page.

Solution Overview

In the scenarios presented in this documentation we will demonstrate how to use ONTAP storage systems as principal storage for VCF VI Workload Domain deployments. In addition, we will install and use ONTAP Tools for VMware vSphere to configure supplemental datastores for VI Workload Domains.

Scenarios covered in this documentation:

- **Configure and use an NFS datastore as principal storage during VI Workload Domain deployment.** Click **here** for deployment steps.
- **Install and demonstrate the use of ONTAP Tools to configure and mount NFS datastores as supplemental storage in VI Workload Domains.** Click **here** for deployment steps.

In this scenario we will demonstrate how to configure an NFS datastore as principal storage for the deployment of a VI Workload Domain in VCF. Where appropriate we will refer to external documentation for the steps that must be performed in VCF's SDDC Manager, and cover those steps that are specific to the storage configuration portion.

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NFS as principal storage for VI Workload Domains

Scenario Overview

This scenario covers the following high level steps:

- Verify networking for the ONTAP storage virtual machine (SVM) and that a logical interface (LIF) is present to carry NFS traffic.
- Create an export policy to allow the ESXi hosts access to the NFS volume.
- Create an NFS volume on the ONTAP storage system.
- Create a Network Pool for NFS and vMotion traffic in SDDC Manager.
- Commission hosts in VCF for use in a VI Workload Domain.
- Deploy a VI Workload Domain in VCF using an NFS datastore as principal storage.
- Install NetApp NFS Plug-in for VMware VAAI

Prerequisites

This scenario requires the following components and configurations:

- NetApp AFF storage system with a storage virtual machine (SVM) configured to allow NFS traffic.
- Logical interface (LIF) has been created on the IP network that is to carry NFS traffic and is associated with the SVM.
- VCF management domain deployment is complete and the SDDC Manager interface is accessible.
- 4 x ESXi hosts configured for communication on the VCF management network.
- IP addresses reserved for vMotion and NFS storage traffic on the VLAN or network segment established for this purpose.

> When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

For information on configuring ONTAP storage systems refer to the ONTAP 9 Documentation center.

For information on configuring VCF refer to VMware Cloud Foundation Documentation.

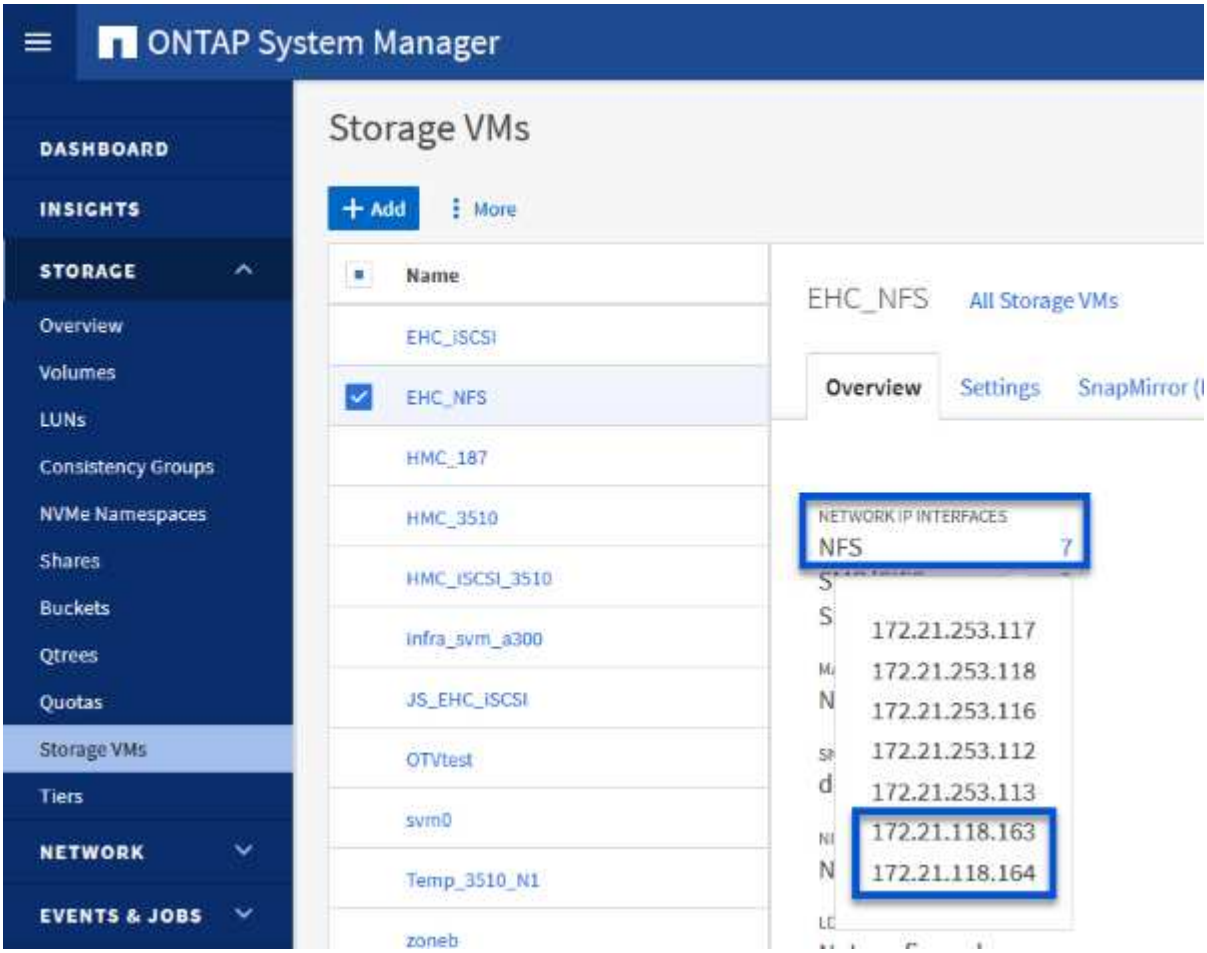
Deployment Steps

To deploy a VI Workload Domain with an NFS datastore as principal storage, complete the following steps:

Verify networking for ONTAP SVM

Verify that the required logical interfaces have been established for the network that will carry NFS traffic between the ONTAP storage cluster and VI Workload Domain.

1. From ONTAP System Manager navigate to **Storage VMs** in the left-hand menu and click on the SVM to be used for NFS traffic. On the **Overview** tab, under **NETWORK IP INTERFACES**, click on the numeric to the right of **NFS**. In the list verify that the required LIF IP addresses are listed.



Alternately, verify the LIFs associated with an SVM from the ONTAP CLI with the following command:

```
network interface show -vserver <SVM_NAME>
```

1. Verify that the ESXi hosts can communicate to the ONTAP NFS Server. Log into the ESXi host via SSH and ping the SVM LIF:

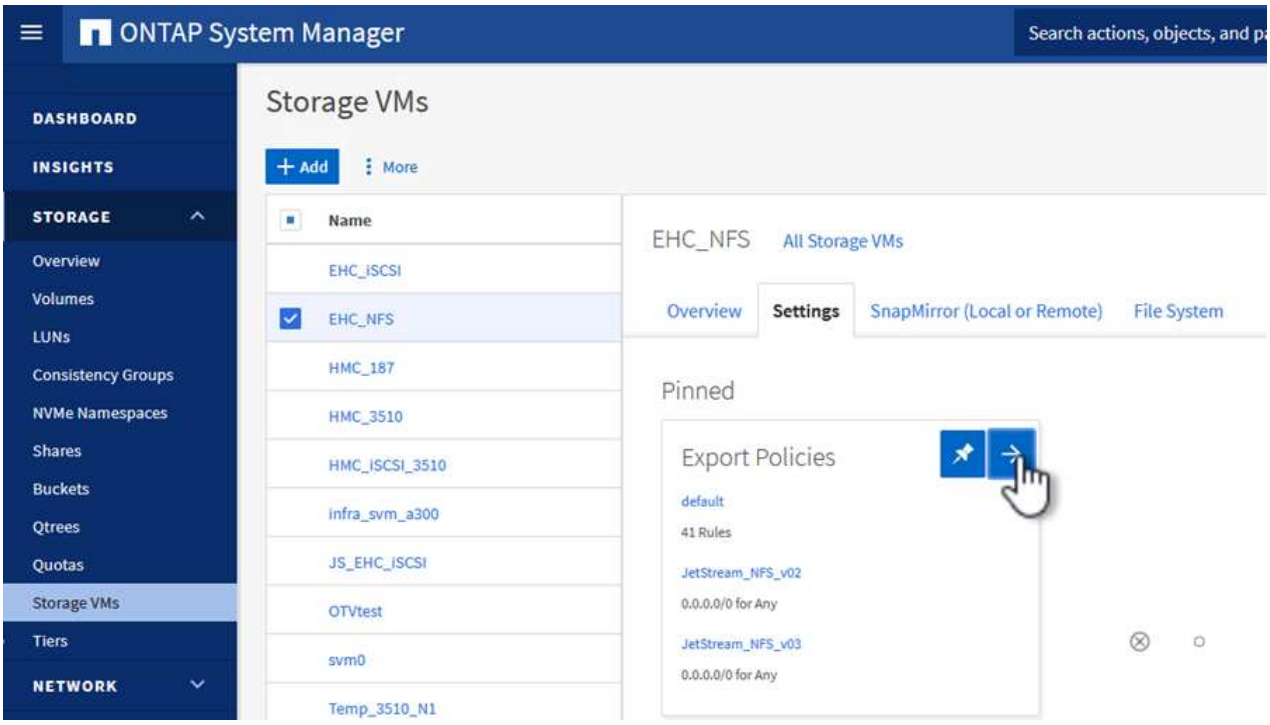
```
vmkping <IP Address>
```

When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

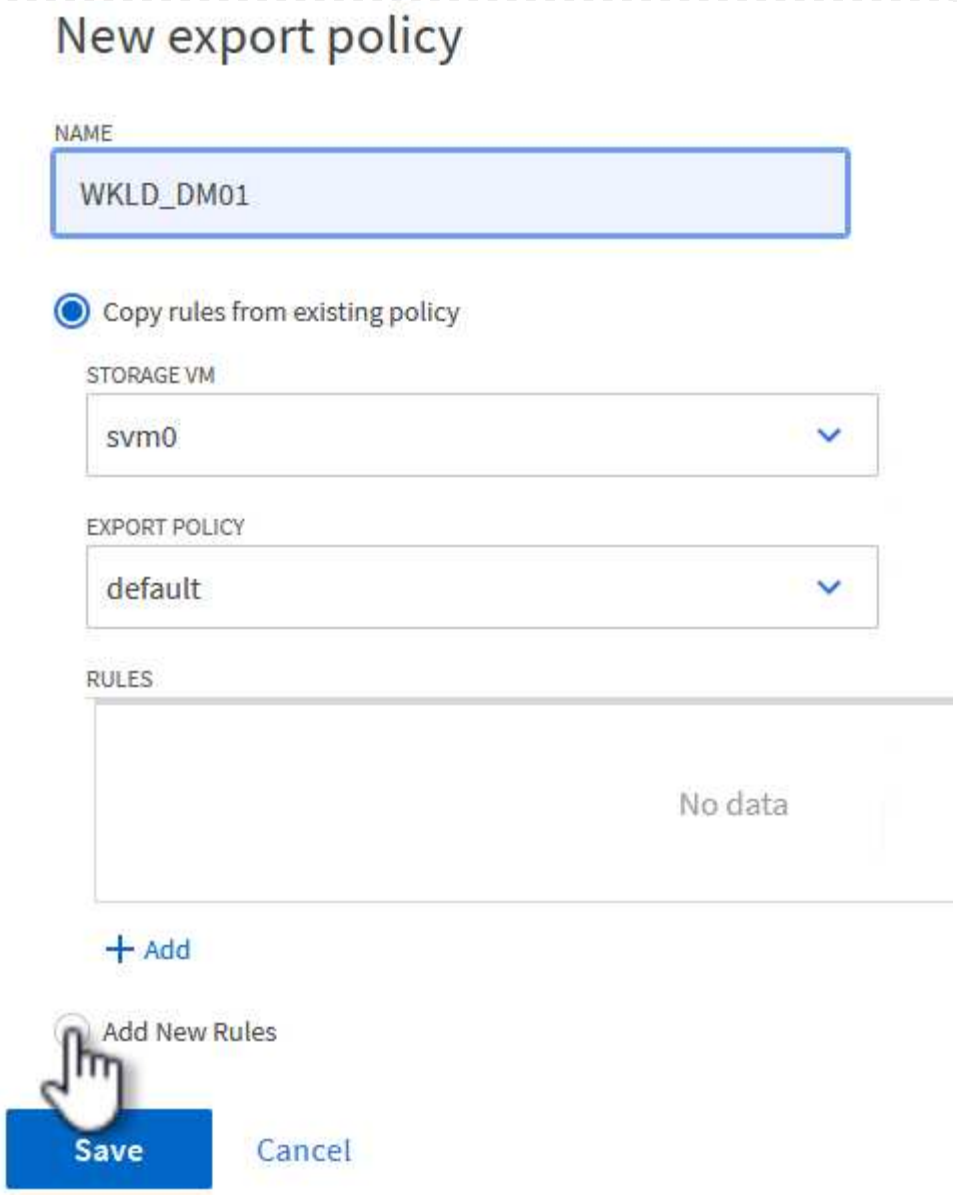
Create Export Policy for sharing NFS volume

Create an export policy in ONTAP System Manager to define access control for NFS volumes.

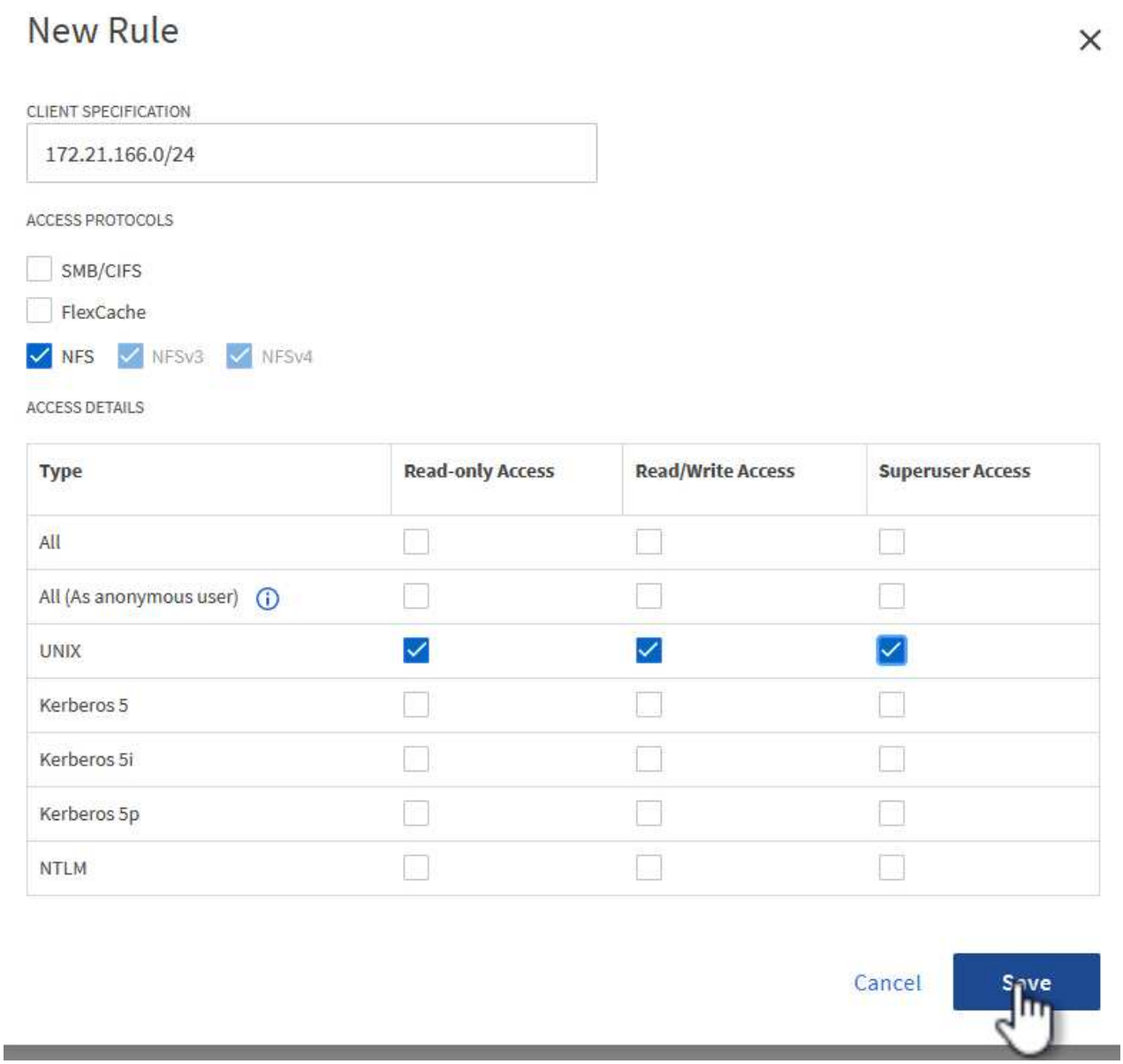
1. In ONTAP System Manager click on **Storage VMs** in the left-hand menu and select an SVM from the list.
2. On the **Settings** tab locate **Export Policies** and click on the arrow to access.



3. In the **New export policy** window add a name for the policy, click on the **Add new rules** button and then on the **+Add** button to begin adding a new rule.



4. Fill in the IP Addresses, IP address range, or network that you wish to include in the rule. Uncheck the **SMB/Cifs** and **FlexCache** boxes and make selections for the access details below. Selecting the UNIX boxes is sufficient for ESXi host access.



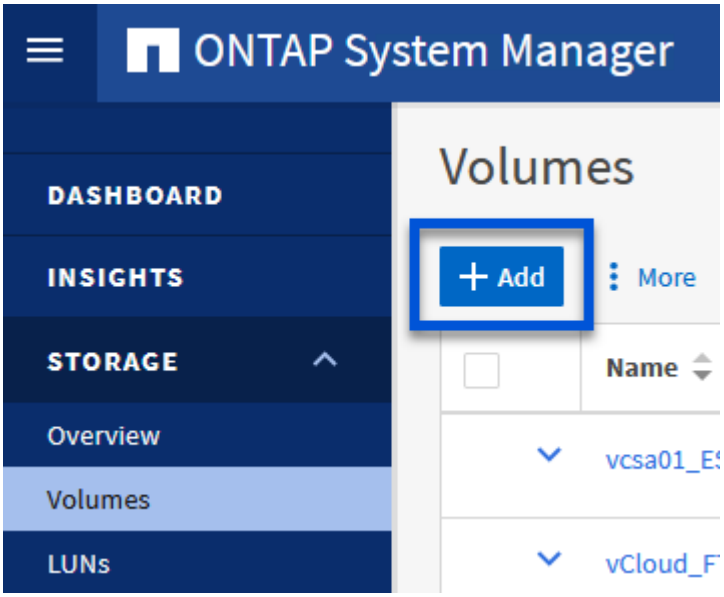
> When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that the export policy includes the VCF management network in order to allow the validation to proceed.

5. Once all rules have been entered click on the **Save** button to save the new Export Policy.
6. Alternately, you can create export policies and rules in the ONTAP CLI. Refer to the steps for creating an export policy and adding rules in the ONTAP documentation.
   - Use the ONTAP CLI to Create an export policy.
   - Use the ONTAP CLI to Add a rule to an export policy.

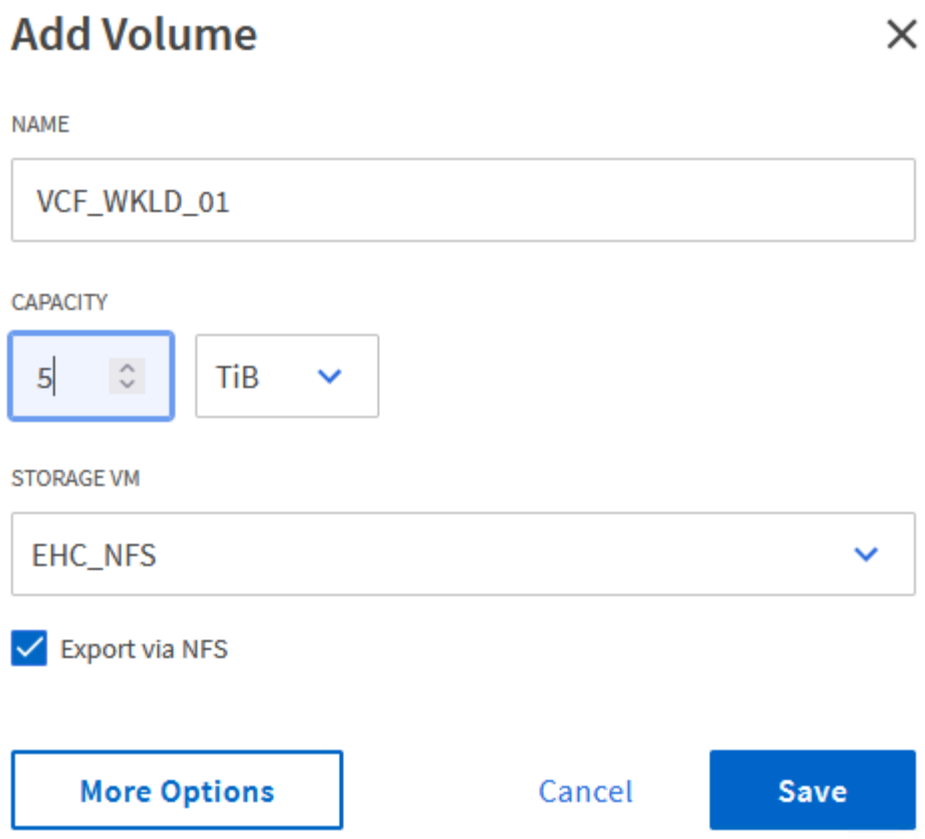
Create NFS volume

Create an NFS volume on the ONTAP storage system to be used as a datastore in the Workload Domain deployment.

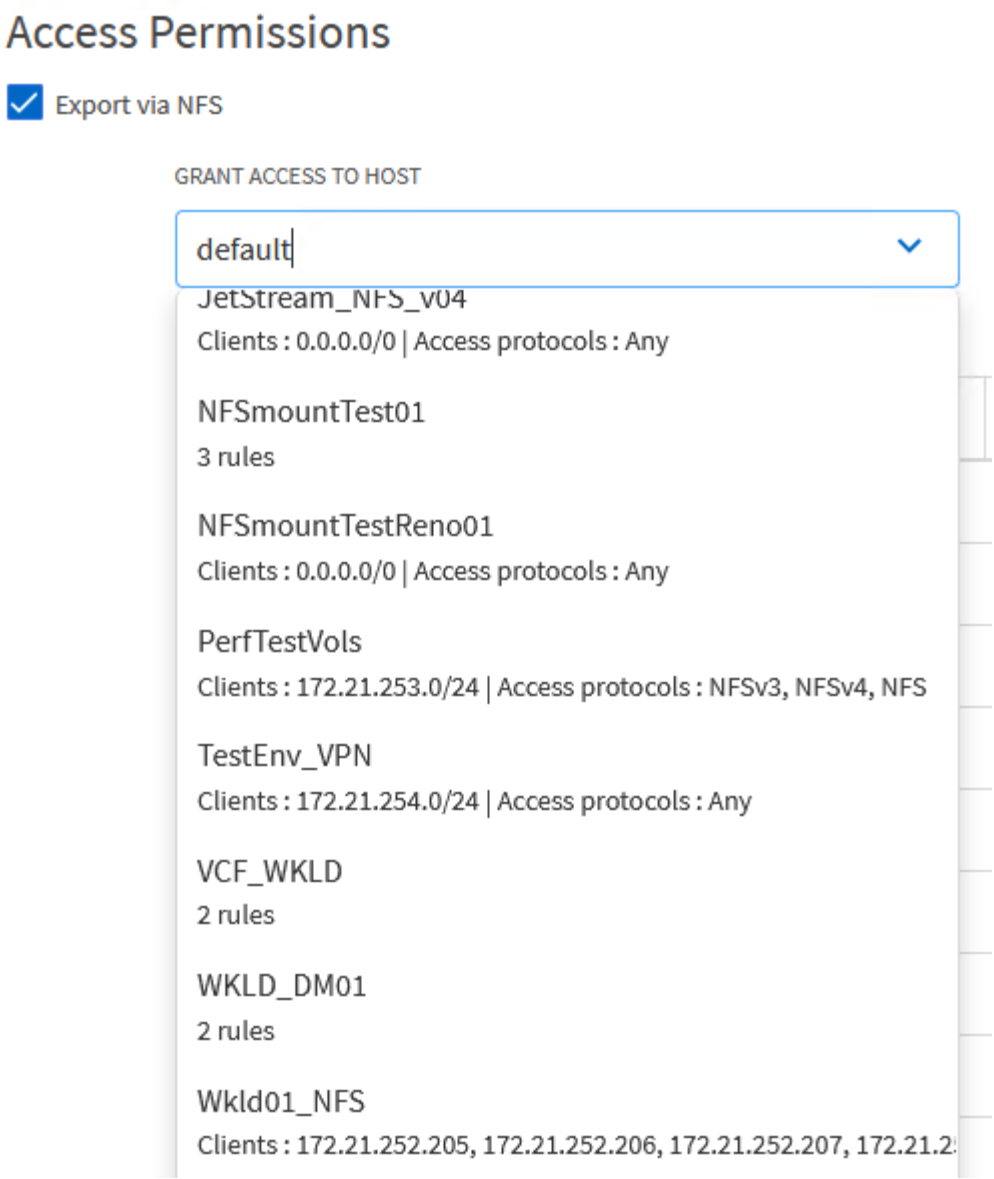
1. From ONTAP System Manager navigate to **Storage > Volumes** in the left-hand menu and click on **+Add** to create a new volume.



2. Add a name for the volume, fill out the desired capacity and selection the storage VM that will host the volume. Click on **More Options** to continue.



3. Under Access Permissions, select the Export Policy which includes the VCF management network or IP address and NFS network IP addresses that will be used for both validation of the NFS Server and NFS traffic.



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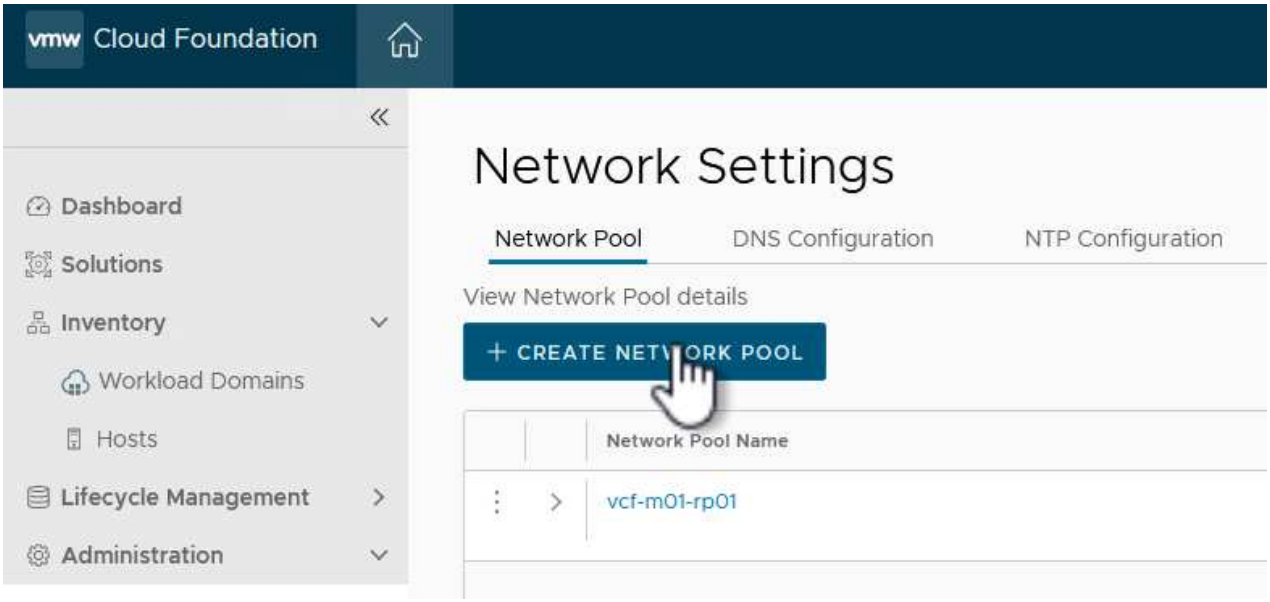
> When deploying a VI Workload Domain, VCF validates connectivity to the NFS Server. This is done using the management adapter on the ESXi hosts before any additional vmkernel adapter is added with the NFS IP address. Therefore, it is necessary to ensure that either 1) the management network is routable to the NFS Server, or 2) a LIF for the management network has been added to the SVM hosting the NFS datastore volume, to ensure that the validation can proceed.

4. Alternately, ONTAP Volumes can be created in the ONTAP CLI. For more information refer to the lun create command in the ONTAP commands documentation.

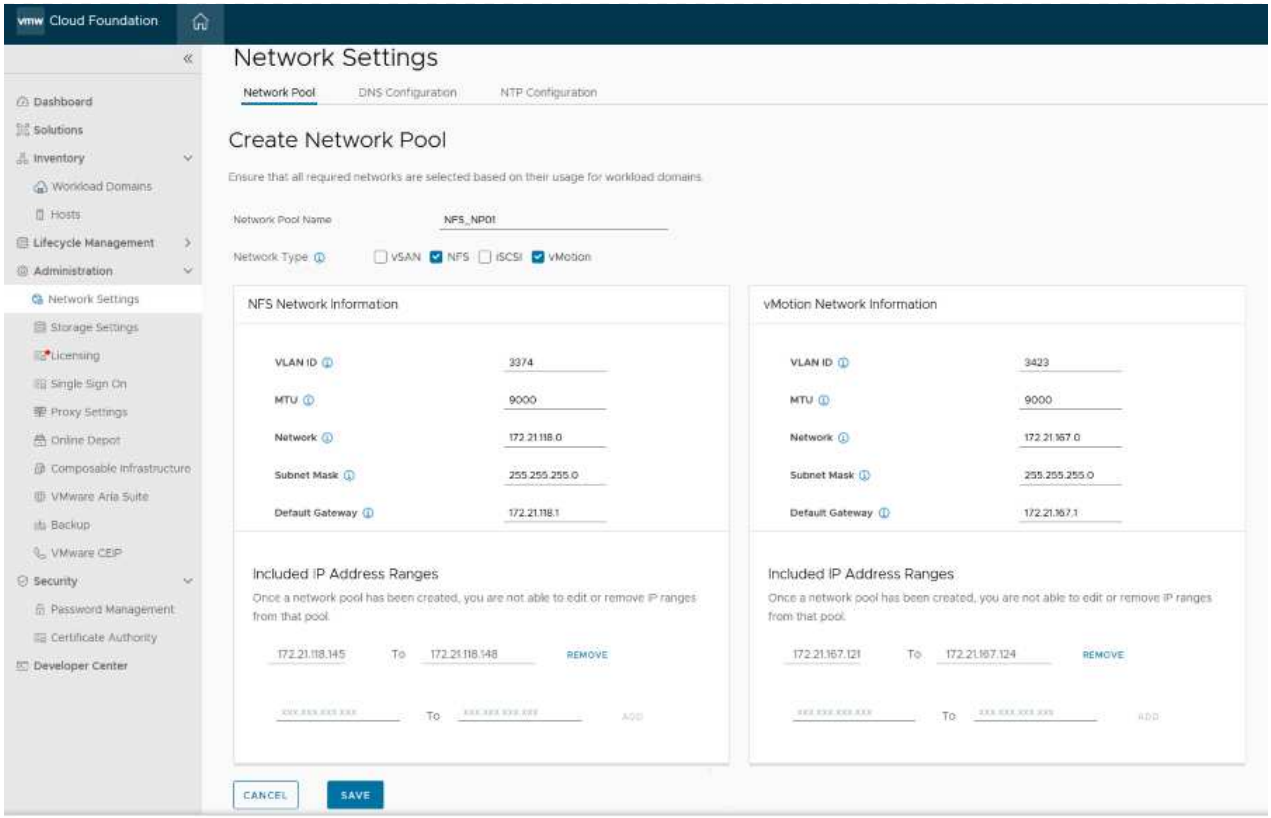
Create Network Pool in SDDC Manager

ANetwork Pool must be created in SDDC Manager before commissioning the ESXi hosts, as preparation for deploying them in a VI Workload Domain. The Network Pool must include the network information and IP address range(s) for VMkernel adapters to be used for communication with the NFS server.

1. From the SDDC Manager web interface navigate to **Network Settings** in the left-hand menu and click on the **+ Create Network Pool** button.



2. Fill out a name for the Network Pool, select the check box for NFS and fill out all networking details. Repeat this for the vMotion network information.



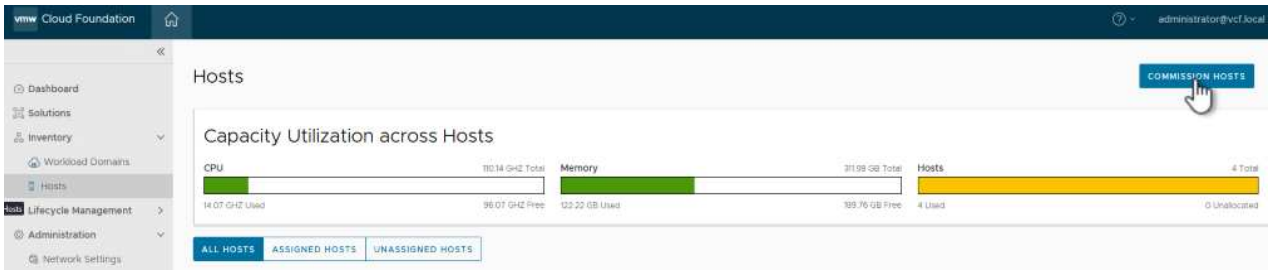
3. Click the **Save** button to complete creating the Network Pool.

Commission Hosts

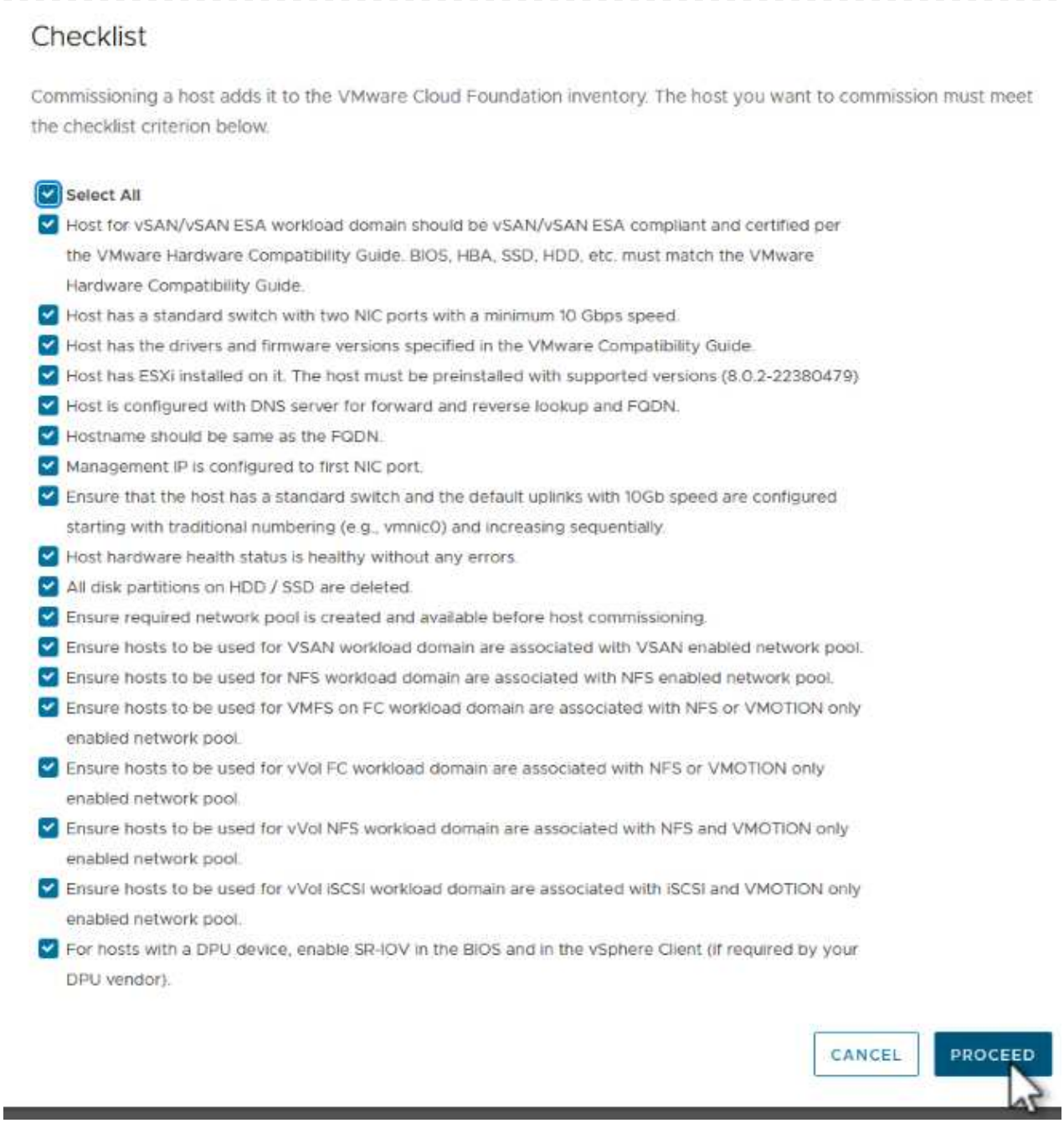
Before ESXi hosts can be deployed as a workload domain they must be added to the SDDC Manager inventory. This involves providing the required information, passing validation and starting the commissioning process.

For more information see Commission Hosts in the VCF Administration Guide.

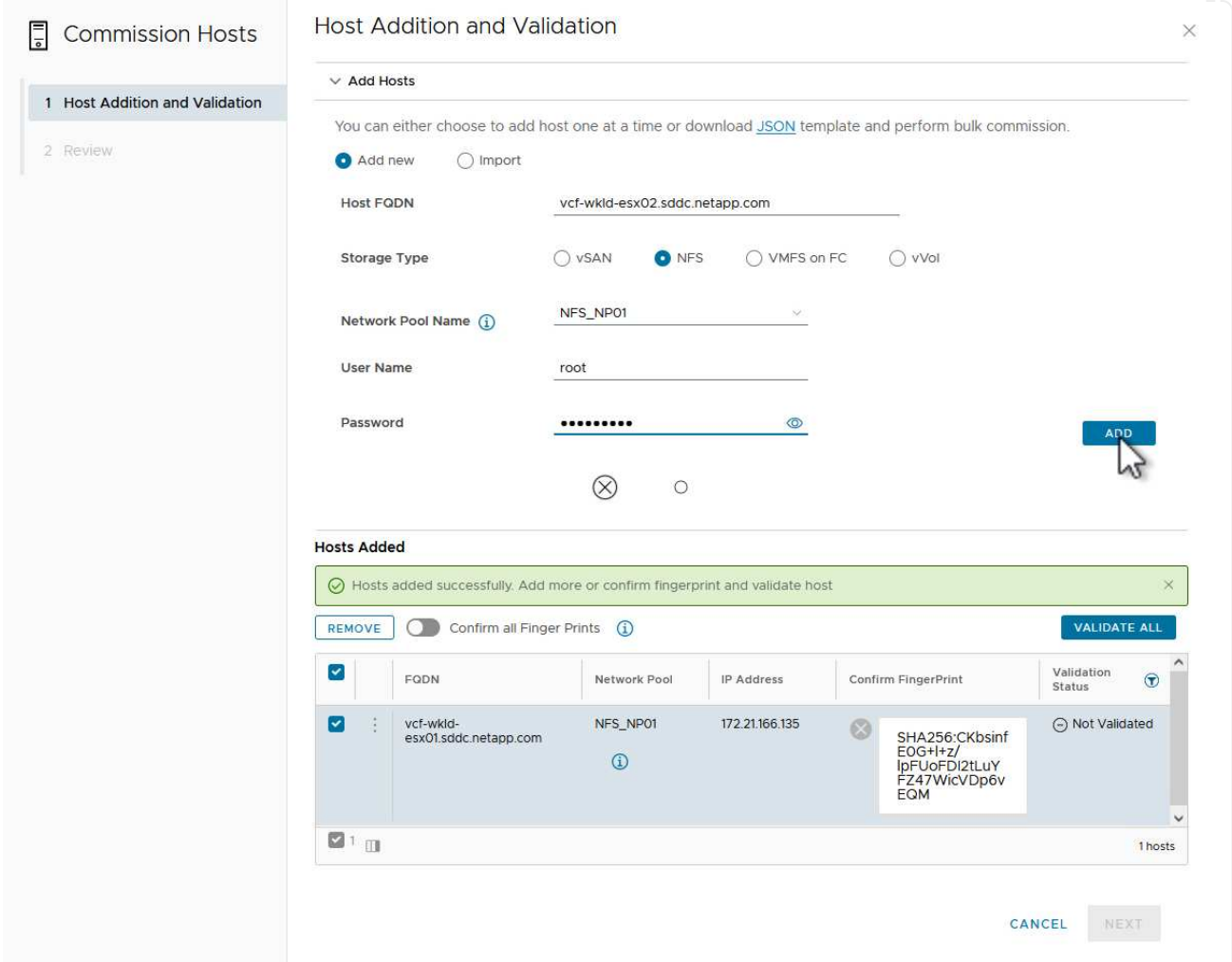
1. From the SDDC Manager interface navigate to **Hosts** in the left-hand menu and click on the **Commission Hosts** button.



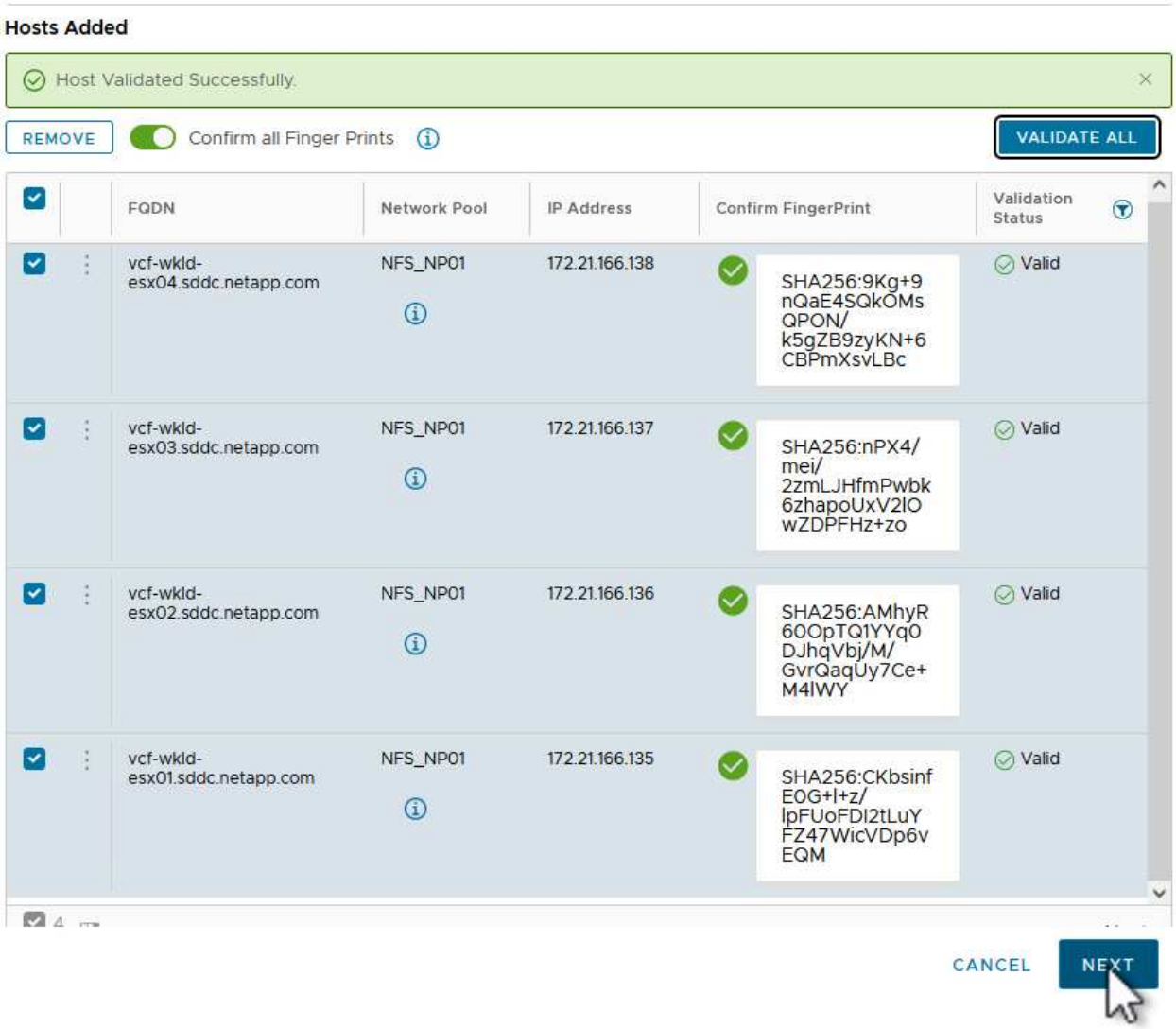
2. The first page is a prerequisite checklist. Double-check all prerequisites and select all checkboxes to proceed.



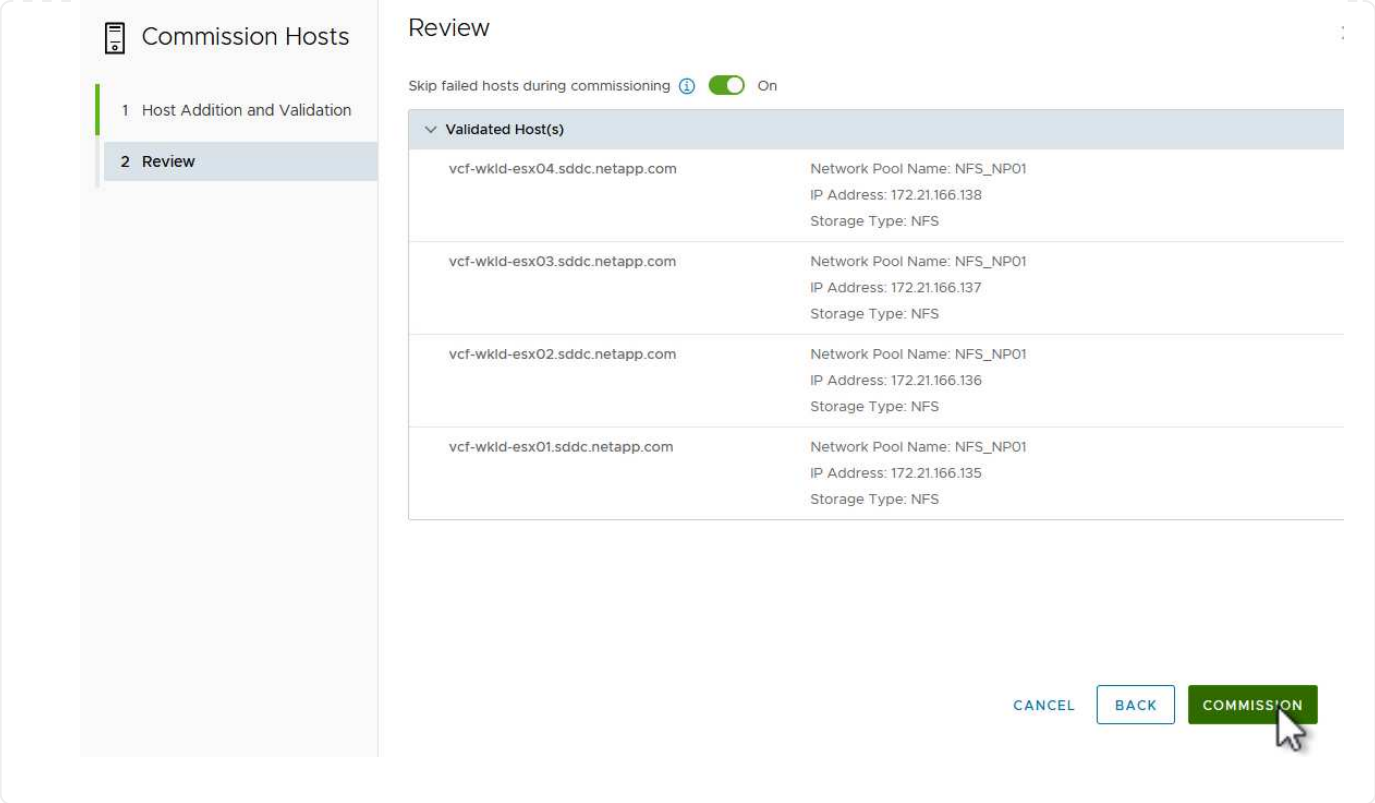
3. In the **Host Addition and Validation** window fill out the **Host FQDN**, **Storage Type**, The **Network Pool** name that includes the vMotion and NFS storage IP addresses to be used for the workload domain, and the credentials to access the ESXi host. Click on **Add** to add the host to the group of hosts to be validated.



4. Once all hosts to be validated have been added, click on the **Validate All** button to continue.
5. Assuming all hosts are validated, click on **Next** to continue.



6. Review the list of hosts to be commissioned and click on the **Commission** button to start the process. Monitor the commissioning process from the Task pane in SDDC manager.

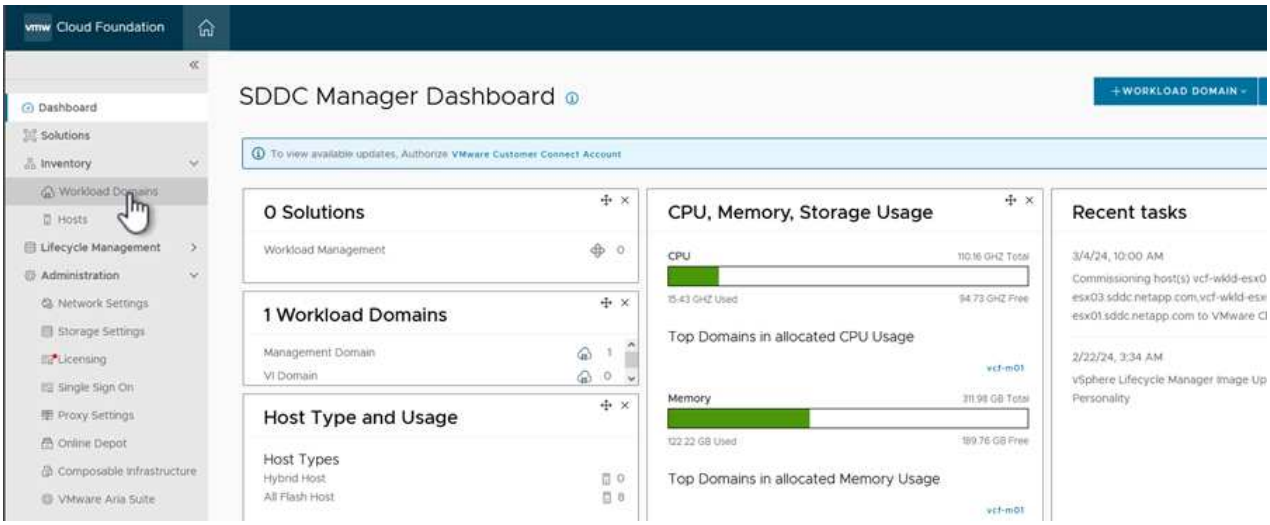

Commission Hosts
1 Host Addition and Validation
2 Review
Review
Skip failed hosts during commissioning
On
Validated Host(s)
vcf-wkld-esx04.sddc.netapp.com
Network Pool Name: NFS_NP01
IP Address: 172.21.166.138
Storage Type: NFS
vcf-wkld-esx03.sddc.netapp.com
Network Pool Name: NFS_NP01
IP Address: 172.21.166.137
Storage Type: NFS
vcf-wkld-esx02.sddc.netapp.com
Network Pool Name: NFS_NP01
IP Address: 172.21.166.136
Storage Type: NFS
vcf-wkld-esx01.sddc.netapp.com
Network Pool Name: NFS_NP01
IP Address: 172.21.166.135
Storage Type: NFS
CANCEL
BACK
COMMISSION

Deploy VI Workload Domain

Deploying VI workload domains is accomplished using the VCF Cloud Manager interface. Only the steps related to the storage configuration will be presented here.

For step-by-step instructions on deploying a VI workload domain refer to Deploy a VI Workload Domain Using the SDDC Manager UI.

1. From the SDDC Manager Dashboard click on **+ Workload Domain** in the upper right hand corner to create a new Workload Domain.

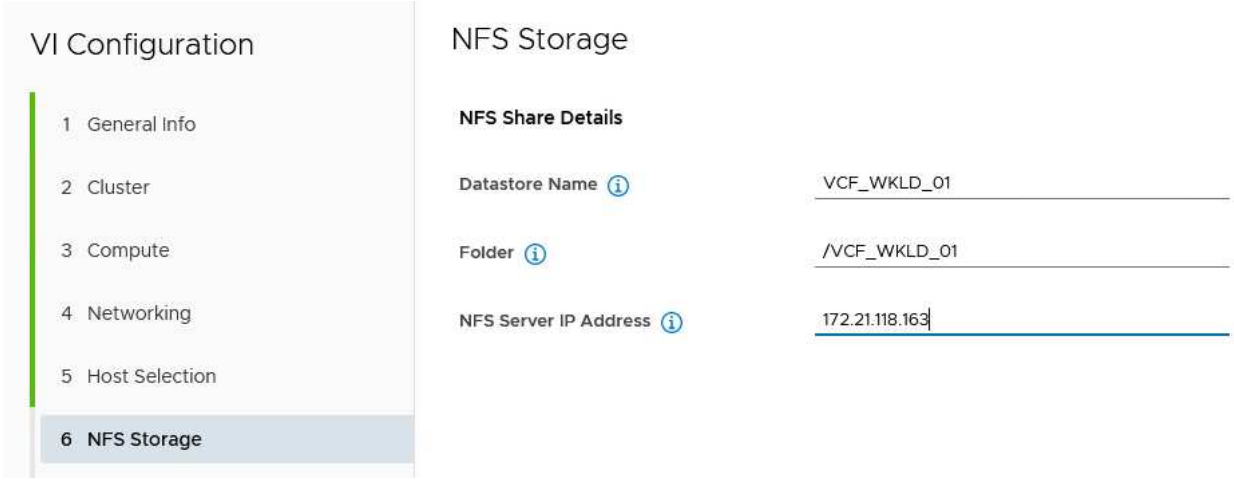


2. In the VI Configuration wizard fill out the sections for **General Info, Cluster, Compute, Networking**, and **Host Selection** as required.

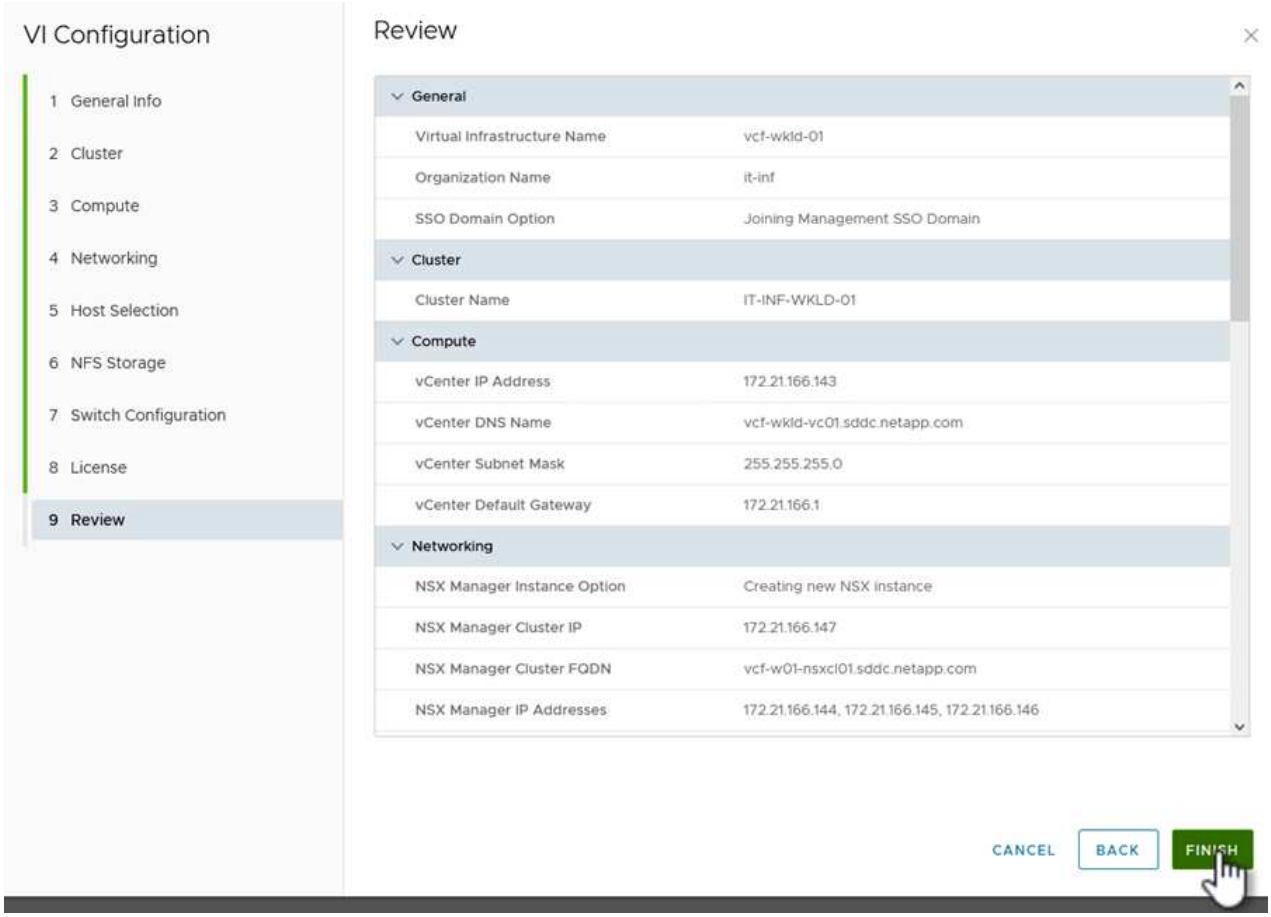
For information on filling out the information required in the VI Configuration wizard refer to Deploy a VI Workload Domain Using the SDDC Manager UI.

+
image::vmware-vcf-aff-image13.png[VI Configuration Wizard]

1. In the NFS Storage section fill out the Datastore Name, the folder mount point of the NFS volume and the IP address of the ONTAP NFS storage VM LIF.



2. In the VI Configuration wizard complete the Switch Configuration and License steps, and then click on **Finish** to start the Workload Domain creation process.



3. Monitor the process and resolve any validation issues that arise during the process.

Install NetApp NFS Plug-in for VMware VAAI

The NetApp NFS Plug-in for VMware VAAI integrates the VMware Virtual Disk Libraries installed on the ESXi host and provides higher performance cloning operations that finish faster. This is a recommended procedure when using ONTAP storage systems with VMware vSphere.

For step-by-step instructions on deploying the NetApp NFS Plug-in for VMware VAAI following the instructions at Install NetApp NFS Plug-in for VMware VAAI.

Video demo for this solution

NFS Datastores as Principal Storage for VCF Workload Domains