#### Purpose:

The Hall C spectrometer magnets and rotation currently rely on a Windows machine, skylla10. This machine is critical. If it were to suddenly and completely fail, it would be days or maybe weeks before the hall would be up and running in any reasonable way. To help mitigate this risk, the server has several hardware redundancies, such as RAID hard drives, auto fail-over power supplies, and some software backups. Despite these precautions, some further points of failure have been identified. Due to the convenience and robustness, a virtual machine is being considered as a backup and/or replacement for skylla10. The virtual machine is hosted on server hardware with the same redundancies, with the added benefit of having an image taken every night and easily restored if something unrecoverable happens to the VM. Additionally, it should be more straightforward to move a VM to new hardware if something unrecoverable happened to the server hardware.

#### Preparation:

To get started, I had to figure out what critical software is running on skylla10. It wasn't clear that there was an accessible document detailing the entire software setup, and with staff changes, the people who set it up intially were no longer reachable. I read Rockwell documentation and explored skylla10 to figure out how the system is setup. This section may be updated as I learn more about the system.

It seems there are several main components to the controls system. The most important hardware are the PLCs. The PLCs are a combination of a primary PLC (and a redundant primary PLC in parallel) for each spectrometer arm that is connected to both the Hall C network via ethernet and to the ControlNet (which is one way Allen-Bradley devices communicate). Also connected to the ControlNet for each spectrometer arm are the secondary PLCs, which house IO cards to interface with electronics in the hall, and ProSoft ControlNet-to-serial converters, which talk to the power supplies, NMRs, etc.

There are two places the data from the PLCs needs to go, the HMI and EPICS. To function, the ESR and CHL cryo plants need certain variables passed to and from the PLCs via EPICS. To pass variables to and from EPICS, there is an OPC server running called KepserverEx, which connects to the primary PLCs and links tags on the PLC to an EPICS PV. The EPICS PV's are hosted on a Windows-based softIOC, called OPCIOCshell. This IOC then reports the PVs to the wider EPICS network. The HMI also requires an OPC server, which is built into Rockwell software called RSLinx. This software serves as both a connection management tool and an OPC server. The HMI software FTView is a combination of an HMI editor, server, and client. The clients simply connect to the HMI server to get the reported values, while the server connects to the RSLinx OPC server and displays the values, as well as logging them. Concurrently with all of the software, there are two licensing servers that host hardware-linked licenses for FTView, RSLogix5000 (the PLC software editor), RSLinx, and KepserverEx. One is a Rockwell based license server, FactoryTalk Activation Manager and the other is called CodeMeter. There is plenty of other supporting software that is needed for this system, but the bulk of it is packaged with the programs that uses it.

After getting a good handle on what exactly was running, I looked at skylla10 to see what software versions were needed for a successful server build. The system is <u>VERY</u> sensitive to the software versions. Incompatibilities between the HMI widgets, different pieces of software, and the various hardware components seem to be extremely likely if the incorrect versions of Rockwell software, or even certain Windows updates, are installed. Below is a list of software and their version numbers that need to be installed:

-FTView SE - 9.00.00 (CPR 9 SR 11.0)

-RSLinx Classic Professional – 4.11.00 (CPR 9 SR 11.0)

-RSNetWorx for ControlNet and DeviceNet (and maybe EtherNet/IP) - 28.00.00 (CPR 9 SR 11)

-FactoryTalk Services – 2.90.00 (CPR 9 SR 9), maybe 6.11.00? The compatibility page seems to think this would be fine.

-RSLogix 5000 – 20.01.00 (CPR 9 SR 5) Not needed on the server machine.

-KepserverEx V6

-OPCIOCShell - v3.8.0.1 is installed on skylla10. Maybe a newer version would be fine for this?

-CodeMeter – This should come with the software that requires is. May need to contact Rockwell support for proper setup.

After creating a list of software to install, I looked on Rockwell's site for download links. You can only download software by creating an account. The account may also need to be approved by the lab's Rockwell manager. Once I had an account, I was able to access the downloads. The downloads require a serial number as well as additional verification. The serial numbers are not included in this document, but there is a supporting document containing them. The serial number must be matched with a product key, purchasing company name, order number, subscription, number, auth number, etc. I found the easiest was to use the company name, once I figured it out. The company name on the account is "Thomas Jefferson Natl Accelerator Fac". The serial number combined with the company name will allow a download of the licensed software in any version that is available under the license. This is not necessarily the same version that is needed for the software to operate. Once I had access to the correct downloads in the correct versions, I download them all at once with Rockwell's download manager (the standard download method). The download is a .exe file that when run, initiates the downloads of the selected software to C:\RA\. When I did this the first time, and then attempted to install the software, every individual program was missing data files. I had to go back and re-download each program separately to get the complete set of files needed for install.

I have some questions about licensing on the VM, since it seems the licenses are bound to the hardware serial numbers, which apparently don't exist for the VM. It seems there is an option to bind to removable storage, and also to MAC ID.

Removable Storage Link: https://activate.rockwellautomation.com/ActivationHelp/25126.htm

MAC ID Link: https://activate.rockwellautomation.com/ActivationHelp/172576.htm

It seems a method for KEPware license binding also uses a MAC ID.

# Link: <u>https://www.kepware.com/en-us/support/knowledge-base/2018/can-i-license-kepserverex-on-a-virtual-machine-cl/</u>

# Website for OPCIOCshell info/download: <u>https://www-csr.bessy.de/control/SoftDist/OPCsupport/</u>

It seems like the latest version of OPCIOCshell would be fine, but I am going to use version 4.1.0.4. We don't use ModBus, which seems to be the main part of the latest update. 3.8.0.1 seems to be the last version that includes the source code, so I will also download that as well, in case support for this program is dropped, or something similar.

## Procedure

- 1. Prepared by downloading each piece of software in the correct version, as detailed above.
- 2. Ran the installer for FactoryTalk Services Platform 6.11.00. It said I needed to restart to complete the installation. I accepted the restart and will do so each time it is requested to be sure things are installing properly.
- 3. Ran the installer for RSLinx Classic Professional and restarted.
- 4. Ran the installer for FT View. This one had me select the specific product I needed from a list. I selected FT View SE Server first. Then it allowed me to select which portions of the install I wanted. I selected FT View SE Client as well, as that was the next piece I intended to install. It also tried to install RSLinx Enterprise 5.90.00 at the same time, but this one failed due to "Higher version installed". I ignored this as the other portions of FT View installed correctly, and I already had the version of RSLinx I needed. Restarted after the install.
- 5. Ran the FT View installer again and selected Studio Enterprise. While this machine should not be used for development, it would be good to have the option to run Studio if necessary. I also selected the other portions of this software available, Viewpoint for ME and SE. Restarted after it was done.
- 6. Ran the installer for RSLogix, (20.01.05 was the only one available), but the installation failed. The log was not helpful. May need to call Rockwell for support. While RSLogix development does not need to happen on this machine, I believe the machine with RSLinx running is the only one that can access the PLC's directly for software uploads, or for modifying tag values on the fly, as is sometimes necessary. Further investigation proved this to be incorrect. RSLogix will not be installed on this machine. To avoid accidental interruptions of service, PLC software development should occur on another machine with the proper software installed.
- 7. Ran the installer for RSNetWorx. This installs, NetWorx for ControlNet, DeviceNet, and Ethernet/IP. Restarted after it finished.
- 8. Ran installer for the KEPserver. Decided not to set an admin password for the moment. We can set it later, when putting the system into production.
- 9. Ran installer for OPCIOCshell. Rebooted when requested.
- 10. I copied the custom files from the OPCIOCshell bin directory on skylla10 over to the bin directory on skylla10-vm1, these include the .db files for the HMS, SHMS, etc as well as the .cmd file to start the ioc. Hopefully, everything will work smoothly, considering they are different versions, however glancing through the file, I don't see anything that should've changed. I can't start it to test yet, because I don't want to cause an issue with duplicate PV names. I also realized that this program needs to be run manually to start. There may be a startup script that runs on skylla10 which I need to bring over.

- 11. I need to find out what other files need to be brought over from skylla10. At least, there is the HMI files. I'm not sure what else needs to be moved.
- 12. I'm hesitant to continue with this at this time. The next steps would likely be to verify the software is working, to backup or migrate the necessary files, and to move the licenses. These steps could potentially interfere with the running of the HMI, so it would be best to wait until the long accelerator down.
- 13. After discovering an issue with controls9, I realized that FactoryTalk Alarms and Events may need to be version 2.90.00. If it is 6.11.00, the trends will not load in the HMI. I may have to change the install on skylla10-vm1. After reinstalling the lower version of FTAE, the trends still didn't work. On the Rockwell Knowledgebase, I found something saying to patch everything to the same point. On skylla10, I found the latest patch bundle to be Feb 04 2019, so I copied them to controls9 and installed them. This fixed the issue. When we have upgraded to skylla10-vm1, we should probably install the latest set of patches on all relevant machines.
- 14. I removed FTAE 6.11.00 from skylla10-vm1, rebooted, then installed FTAE 2.90.00, rebooted again, and installed the patches before a final reboot.
- 15. I picked up somewhere else, and some steps are lost.
- 16. Product keys needed for rehosting. IMPORTANT INFORMATION:

Product	Serial Number	Product Key
View Studio	2529001509	Y4XB6-E9FCM
View Client	2524002439	PFRAV-BXM2G
View Client	2524002440	HXK47-MRDTF
View Client	2524002441	RXNCK-3MYE2
View Server	2556011277	BYA6H-EDWXE
RSLinx	1008059515	CTKXE-A82DE
RSLogix	2022004805	7JYTH-R3PC7
RsLogix	2022011280	WBE6L-2HT3B

## Historian migration guide:

https://literature.rockwellautomation.com/idc/groups/literature/documents/rm/hse-rm001\_-en-e.pdf

#### View users guide:

https://literature.rockwellautomation.com/idc/groups/literature/documents/um/viewse-um006\_-ene.pdf

https://literature.rockwellautomation.com/idc/groups/literature/documents/in/viewse-in003\_-en-e.pdf

#### Kepserver:

## Restoration on Skylla10-vm1

So far, I have backed up and restored the rslinx classic configuration, the fazctorytalk directory, and the hmi servers. I also exported and then imported the kepserver databases.

## EPICS:

The EPICS connection is the hard part because I don't think OPCIOCShell is currently supported anylonger. I can't find a place to download the original files, so I'm probably going to rebuild the EPICS connection using the new OPC UA module. The first step either way, is to install EPICS on Windows. For that, I'm following the instructions here: <u>https://docs.epics-controls.org/en/latest/getting-</u>started/installation-windows.html.

I found an older installer that I had downloaded last year. I put the installer in the "Move to VM" folder. I tried running the script that seems to start the EPICS stuff, but it didn't work...

I installed the previous version of OPC IOC, version 3.8.0.1 and that one had all the necessary libraries. I also had to update the initialization script to point to the correct directory and comment out the MOLLER stuff. Everything seems to be running correctly now!

I had to activate the KepServer by releasing the activation file on skylla10, then uploading the released file to Kepware's website, then request a new activation on skylla10-vm1, upload that file, and then they generated a file for me to download and import on skylla10-vm1. I didn't have to talk to anyone or anything to get this moved. The file is now activated under my name and work email address.

There is an issue with OPCIOCSHell. I can't get other machines to see the PV's. It is most likely an issue with EPICS\_CA\_ADDR\_LIST variable thanks to moving the ioc form machine to another.

Brian Bevins and Scott Higgins helped get this going. They had to change the EPICS\_CA\_ADDR\_LIST on the mya server to look for the values.

The Kepserver is not activated and needs to be. Moving the kepserver requires active service plan.

There was an issue with SHMS tags not resolving. It turned out the SHMS OPC server wasnt set to "Remote OPC server". After changing it, the values resolved.

Now there is an issue that the data logger doesnt start automatically, and has to be manually started. I will nheed to look uip how to automatically start that process.

## The datalogger has been fixed!

The datalogger runs on an SQL server. The SQL server has to be installed, as well as the SSMS, SQL Server Management Software. From the SSMS, you can backup and restore databases. I had to backup every database on skylla10, then restore it individually on skylla10-vm1. I installed SQL server 2022 and setup a new server called DATALOGGER. To create the connection between the SQL server and the datalogger, you have to navigate to C:\Windows\Syswow64\odbcad32.exe and run it. Set up a new system connection for each database. This process is pretty self-explanatory, and it described in knowledgebase ID: QA39884, however this document requires TechConnect to access. Fortunately, I have a printed copy that will be scanned in and stored with this set of notes. After the connection was

set up, I had to DatalogMergeToPrimary to get the temporary database data to sync with the primary database after the connection was restored. All the data from Skylla10 was recovered!