Anatomy of an Attack

~~Two~~ One ICS Attack Vector and How to Defend Against It

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Agenda

- Threat Landscape
- Today's Response
- Anatomy of an Attack: Malicious Insider

Industrial Control System Cyber Attack Sources

External Threats

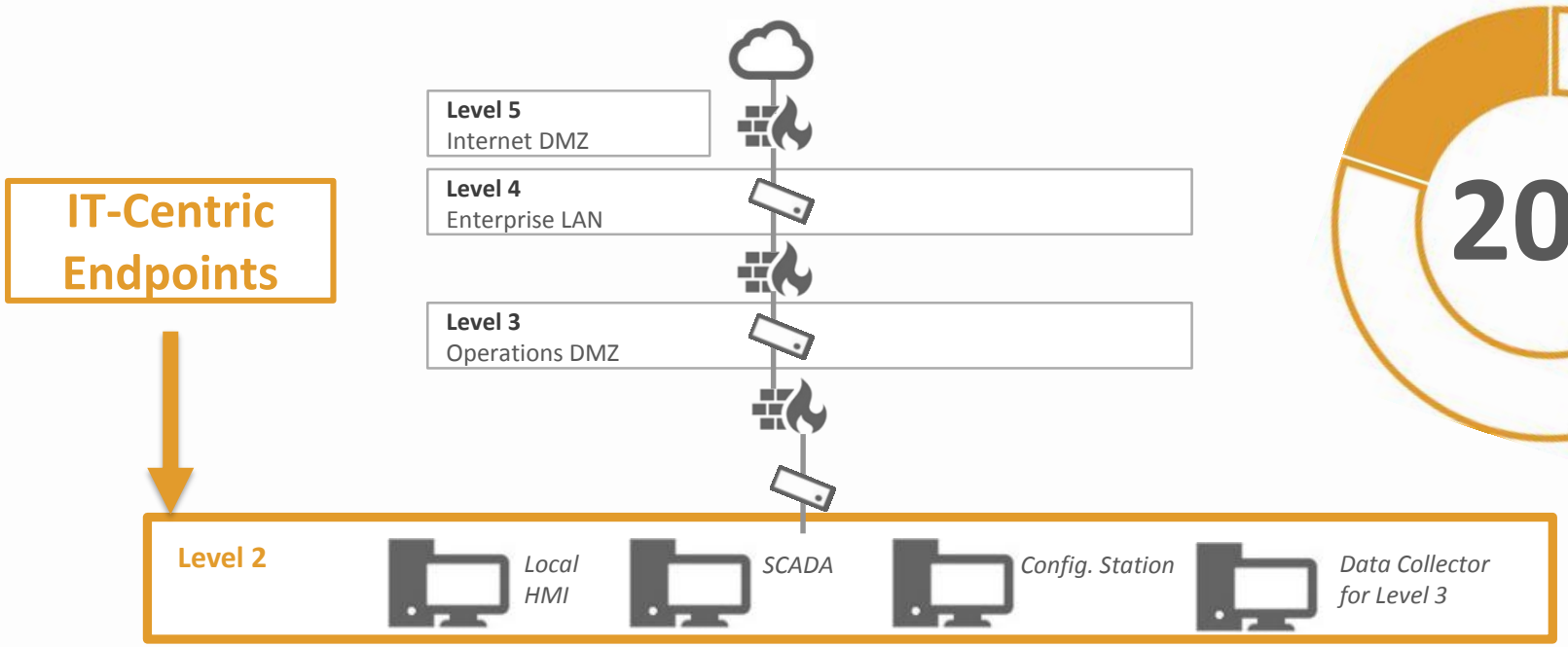
- ICS attacks up 7x from ‘10 to ’16 (1)
- 39.2% of industrial enterprise technology infrastructure attacked in 2016 (2)

Internal Threats

- 60% of attacks are insiders – 44.5% malicious & 15% inadvertent (3)
- Top BoD and CISO spending focus

(1) ICS-CERT Year in Review: Industrial Control Systems Cyber Emergency Response Team 2016
(2) Kaspersky Lab ICS Cert: Threat Landscape of Industrial Automation Systems in the Second Half of 2016
(3) IBM X-Force Research, 2016 Cyber Security Intelligence Index

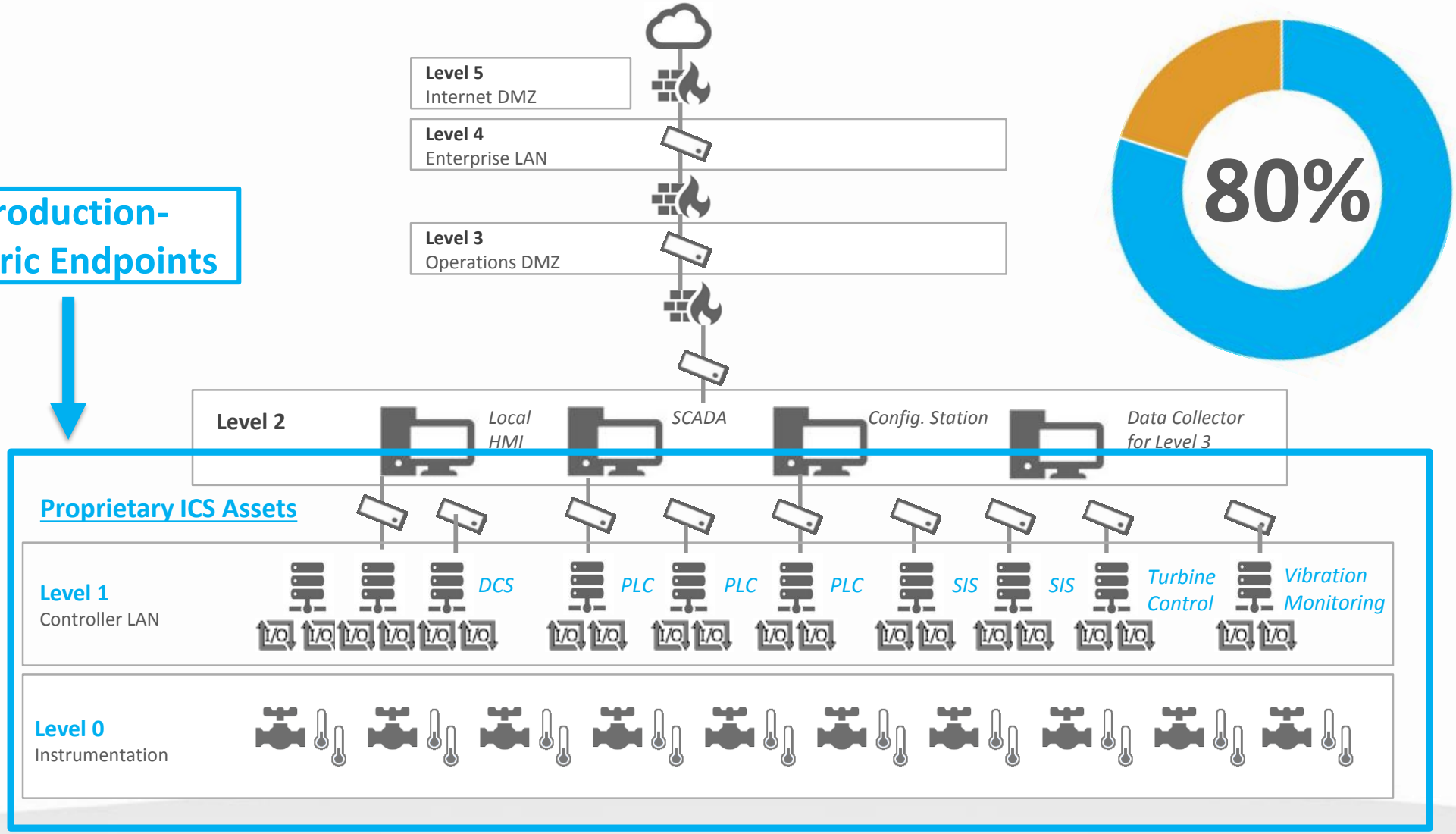
Today's IT-Centric Approach Incomplete



- Network Segmentation
- Perimeter-based Protection
- Anti-virus Software
- Air Gapping
- Security by Obscurity
- Access Controls

Production-Centric Endpoints

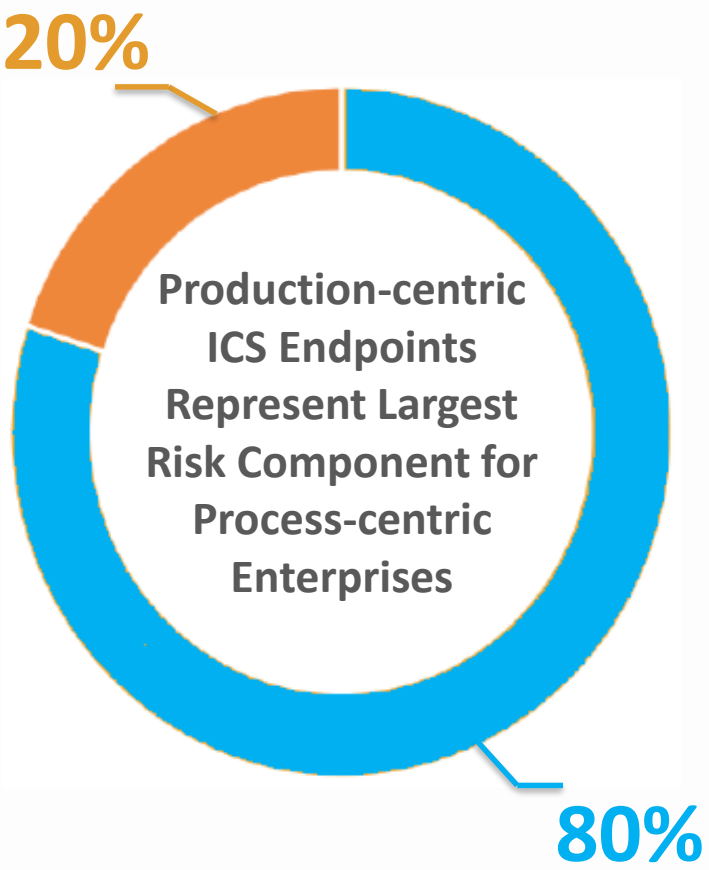
Production-Centric Endpoints



IT-Centric vs Production-cCentric Endpoints

Traditional IT-Centric Endpoints

- Windows/Unix/Linus based, common protocols
- IP addressable
- Agent software friendly
- Readily discoverable/able to interrogate servers, PCs, routers)
- Vendors such as IBM/Lenovo, Dell, HP, and Cisco Systems

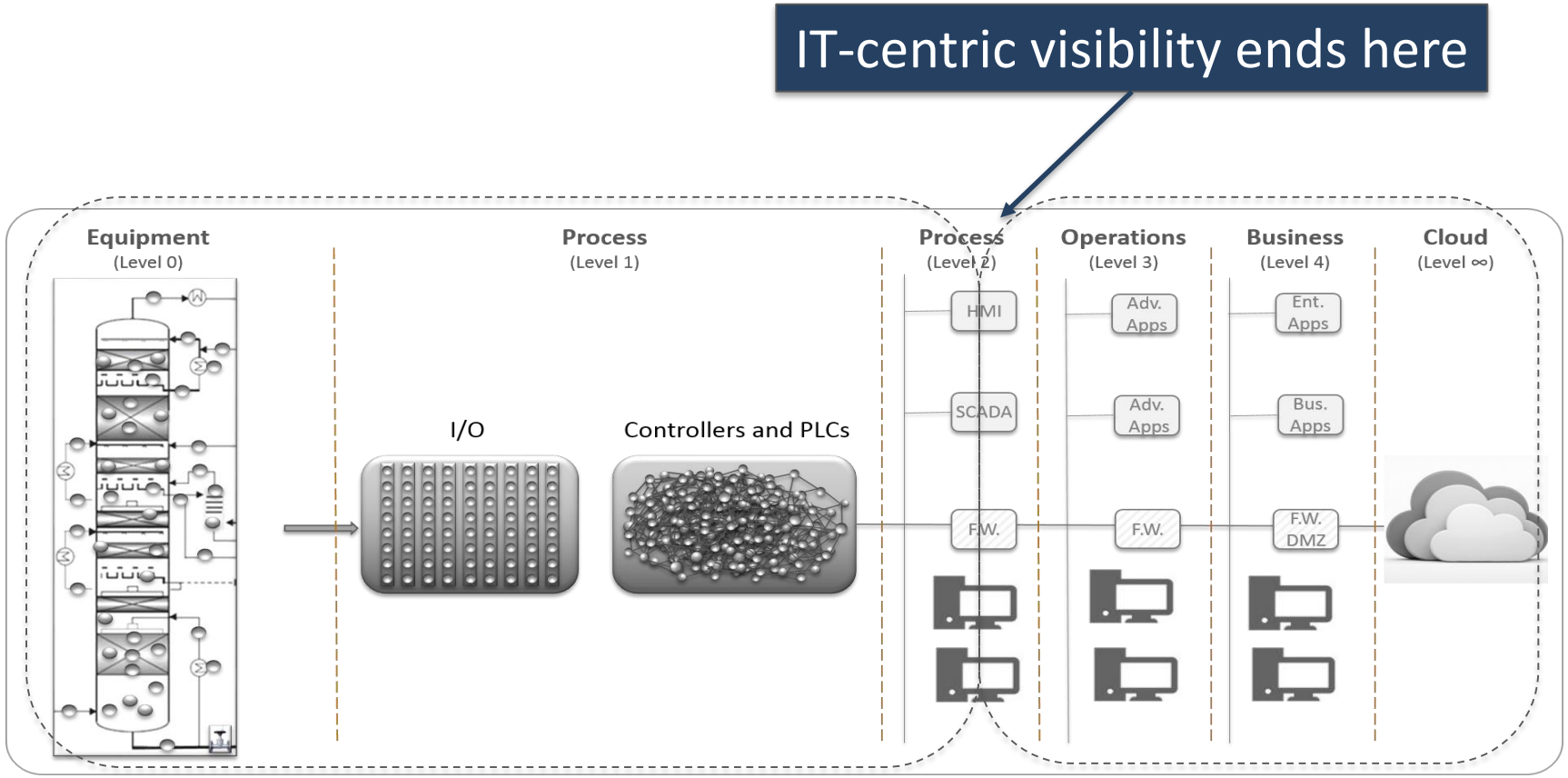


Production-Centric Endpoints

- Heterogeneous, proprietary systems, complex architectures
- Incompatible with agent technology
- “Hidden” endpoints – I/O cards, firmware, installed software, configuration, etc.
- Vendors such as ABB, Emerson, Honeywell, Yokogawa, Siemens, Schneider, Rockwell, & more…

Scenario 1 – Malicious Insider

Major Gap - Limited Level 1 and 0 Visibility

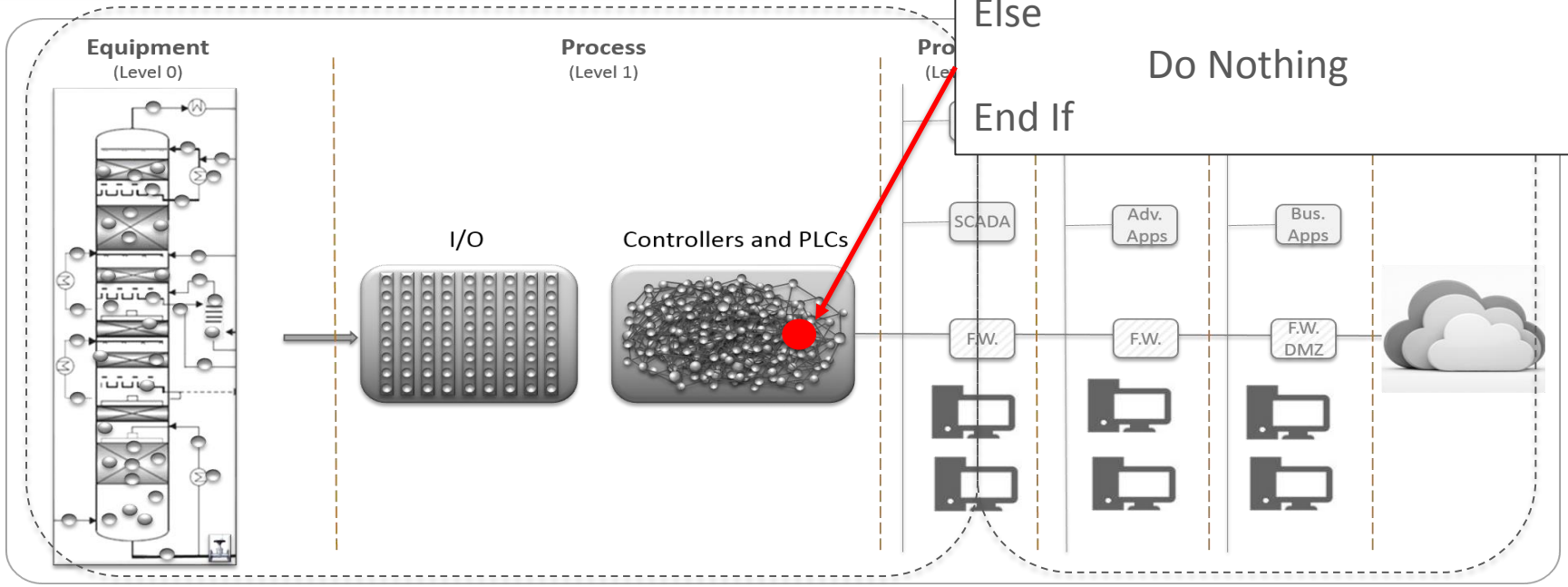


Some Protection Built-in – But Not Enough

The system will do nothing if Setpoint value outside of engineered range

Example Logic:

```
If FC001.SP >= FC001.Low Range And _
   FC001.SP <= FC001.High Range Then
            Run Normal PID Error Handling
Else
            Do Nothing
End If
```

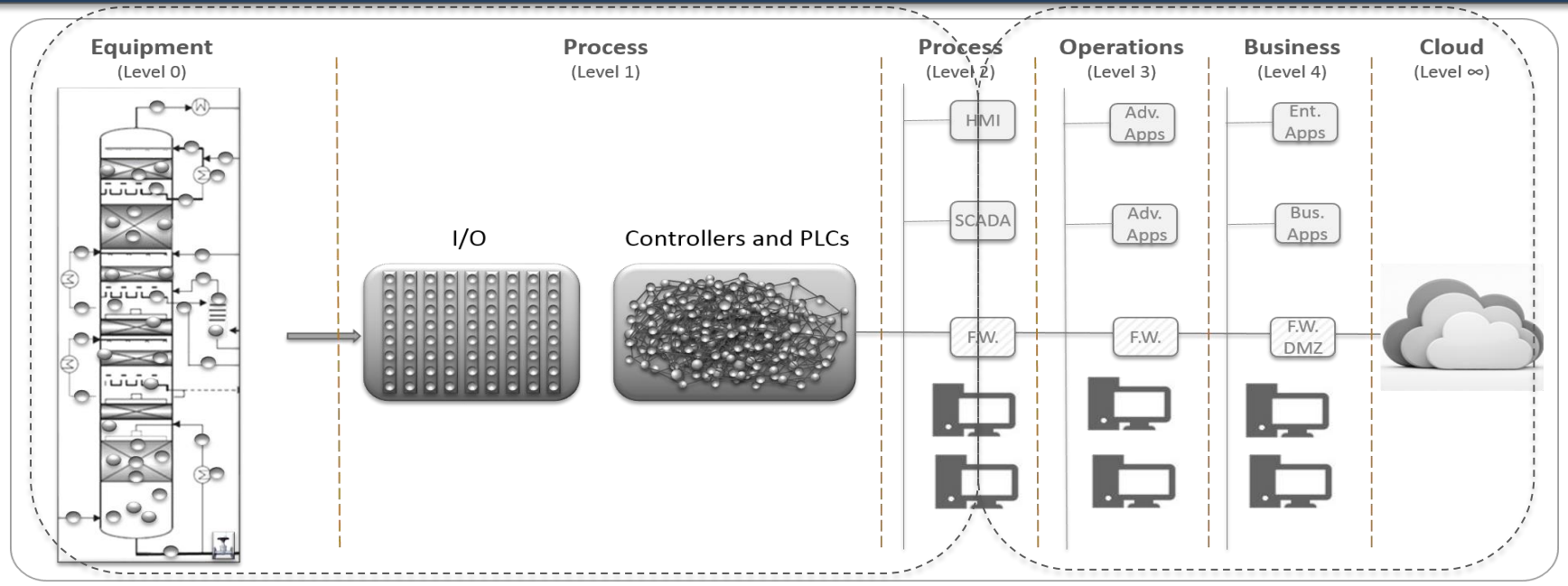


Scenario Summary

First, a malicious offline Engineering Configurator Project Change is made – BUT NOT DOWNLOADED!

Then, an authorized change is made and downloaded

Consequences - process shuts down

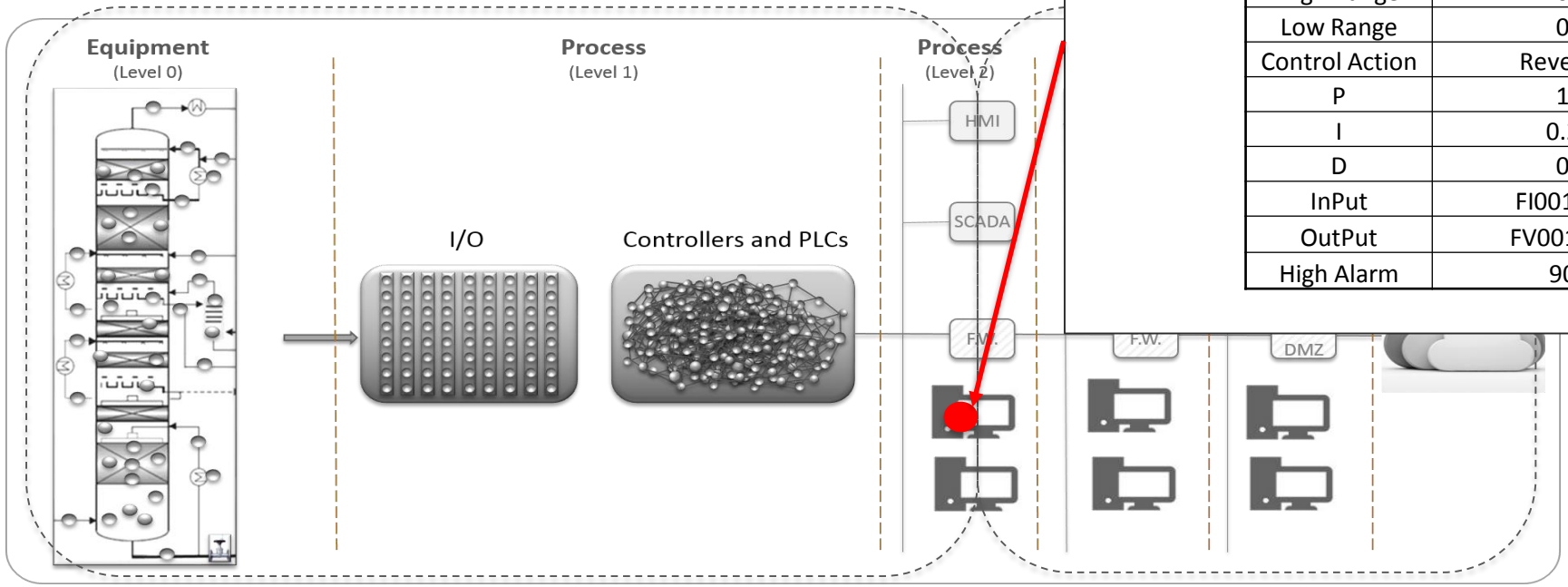


System Before Change

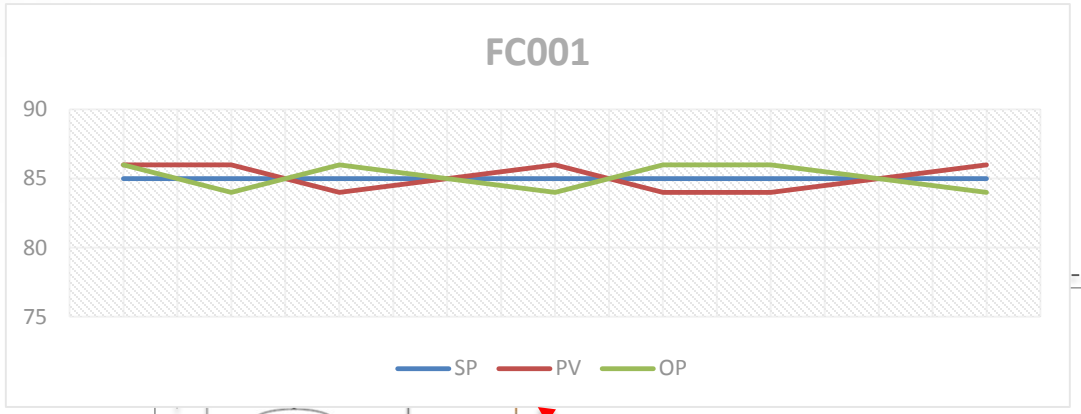
Configurator project before the change

Example Flow Controller Configuration:

FC001 Configuration	
Parameter	**Value**
Name	FC001
Description	Flow to Reactor
Engineering Unit	BPH
High Range	100
Low Range	0
Control Action	Reverse
P	1
I	0.2
D	0
InPut	FI001.PV
OutPut	FV001.OP
High Alarm	90



System Before Change



Operator Settings:

FC001.SP = 85 BPH (Target Value)

FC001.PV = ~85 BPH (Actual Value) (17.6 Milliamps)

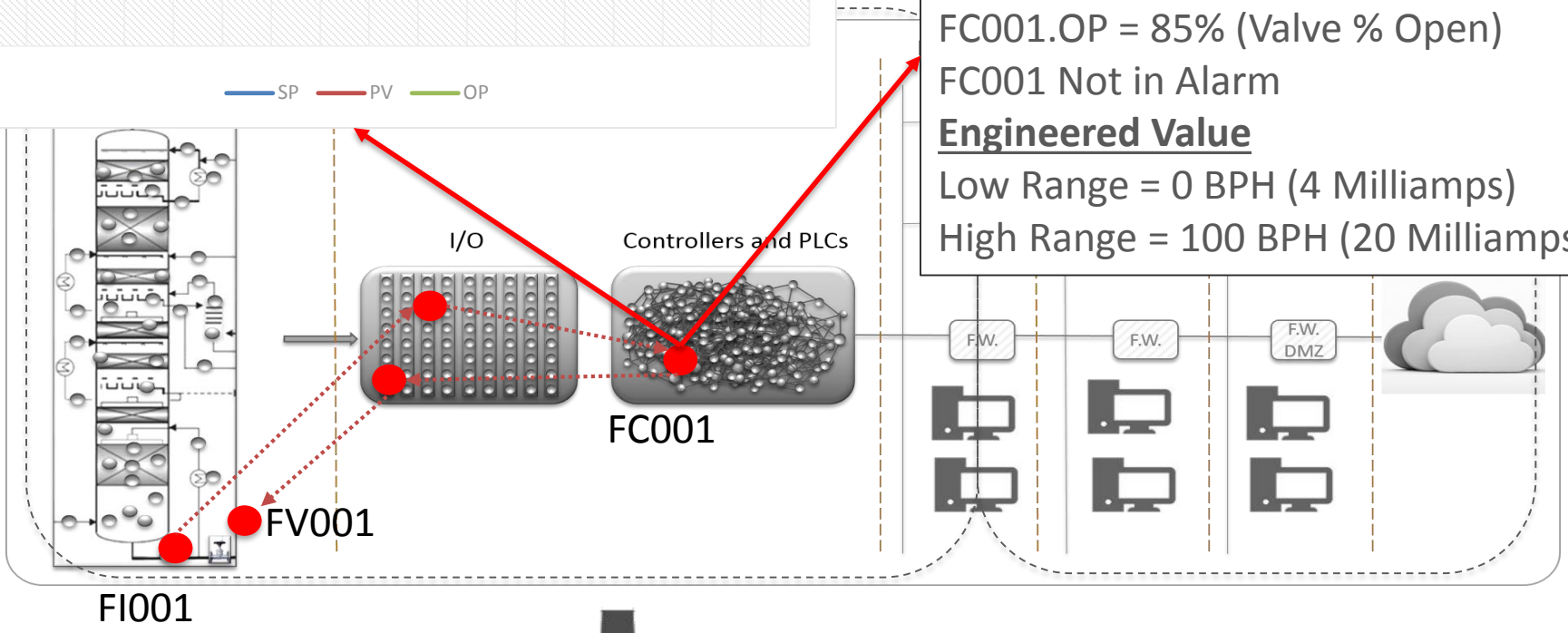
FC001.OP = 85% (Valve % Open)

FC001 Not in Alarm

Engineered Value

Low Range = 0 BPH (4 Milliamps)

High Range = 100 BPH (20 Milliamps)



Action 1 – Malicious Insider Makes Offline Change

Configurator project after the change
High Range changed from 100 to 10

Example Flow Controller Configuration:

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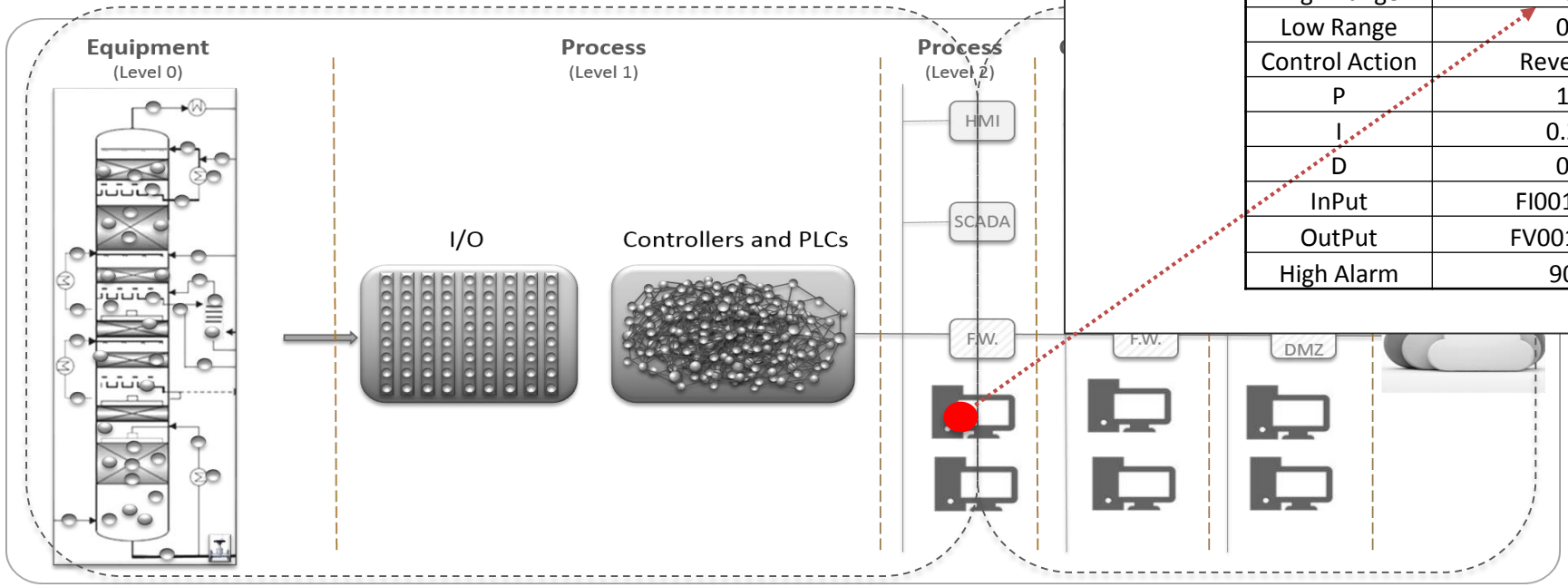

Action 2 – Authorized Change Made

PID Integral changed from .2 to .3

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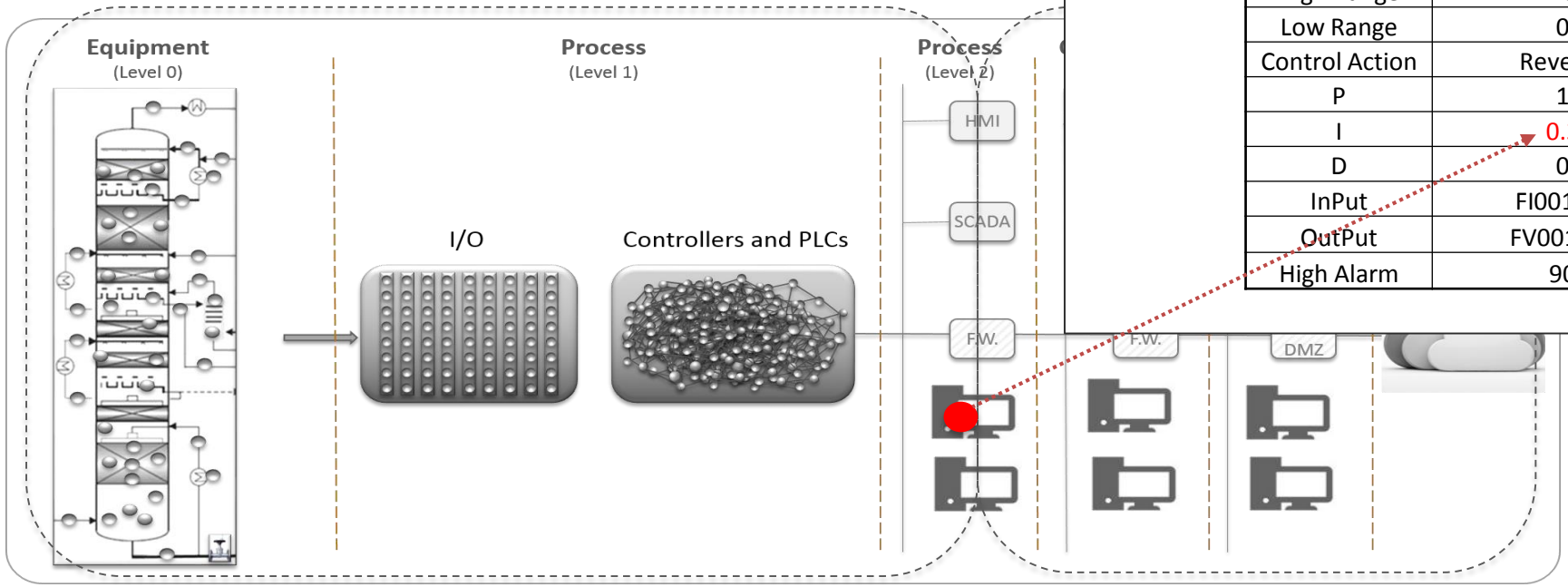
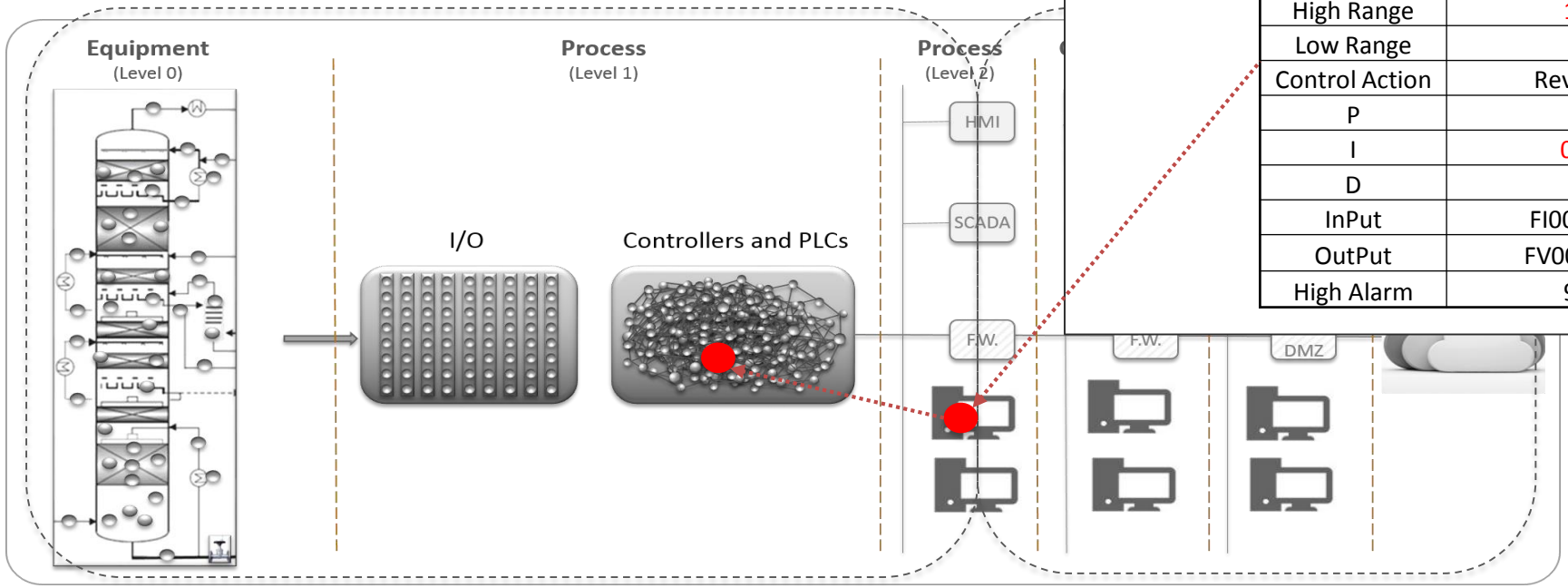


Action 2 Continued – Download to Flow Controller



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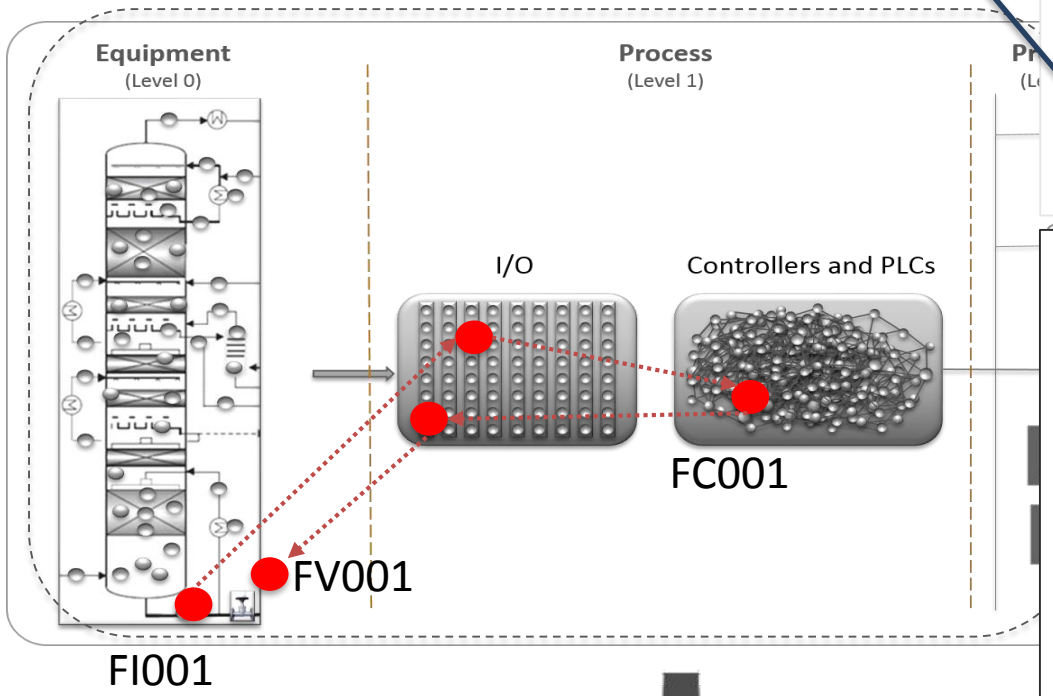
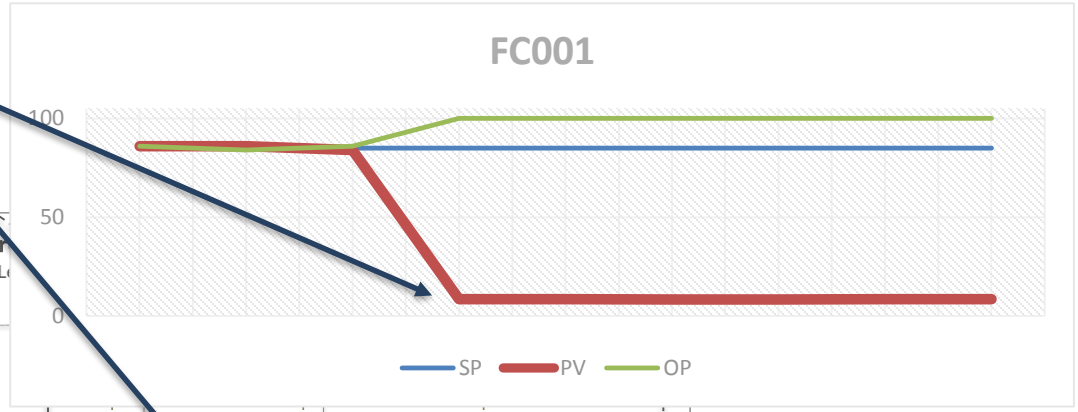
Consequences of the Change

Factor of 10 decrease in High Range Flow Controller calculates 8.5 BPH





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FC001 Not in Alarm

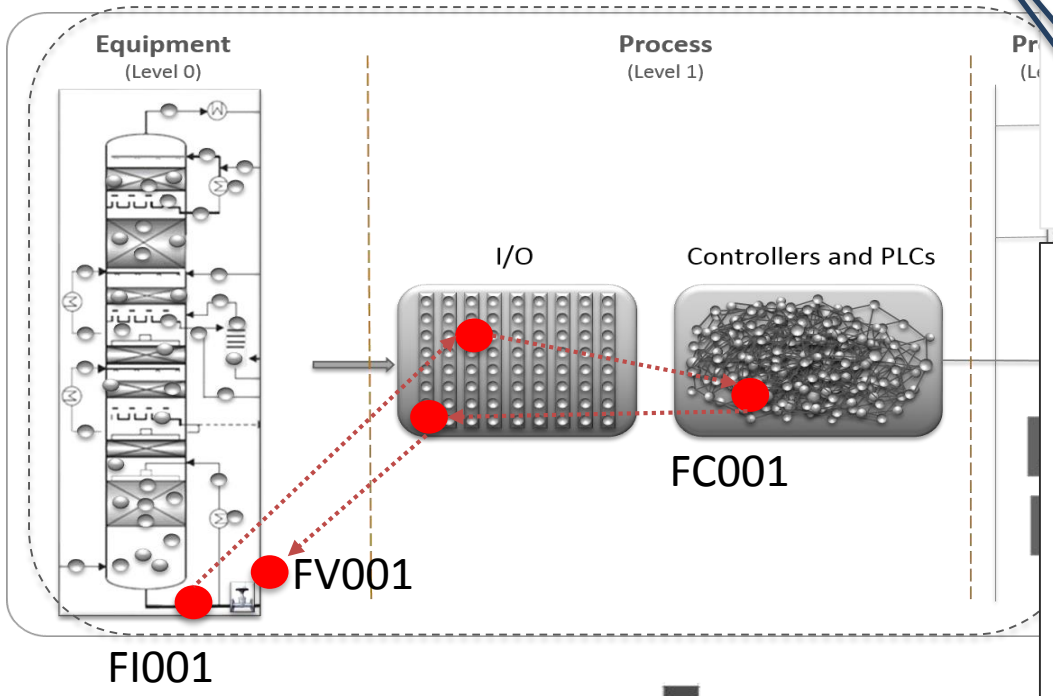
Engineered Value

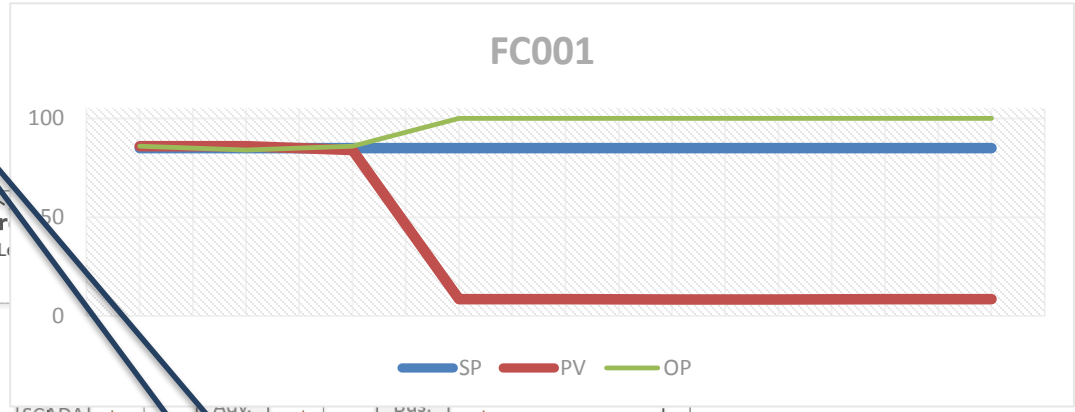
Low Range = 0 BPH (4 Milliamps)

High Range = 10 BPH (20 Milliamps)

Consequences of the Change

Now there is a greater deviation between Setpoint (Target Value) and Process Value (Actual Value)





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Engineered Value

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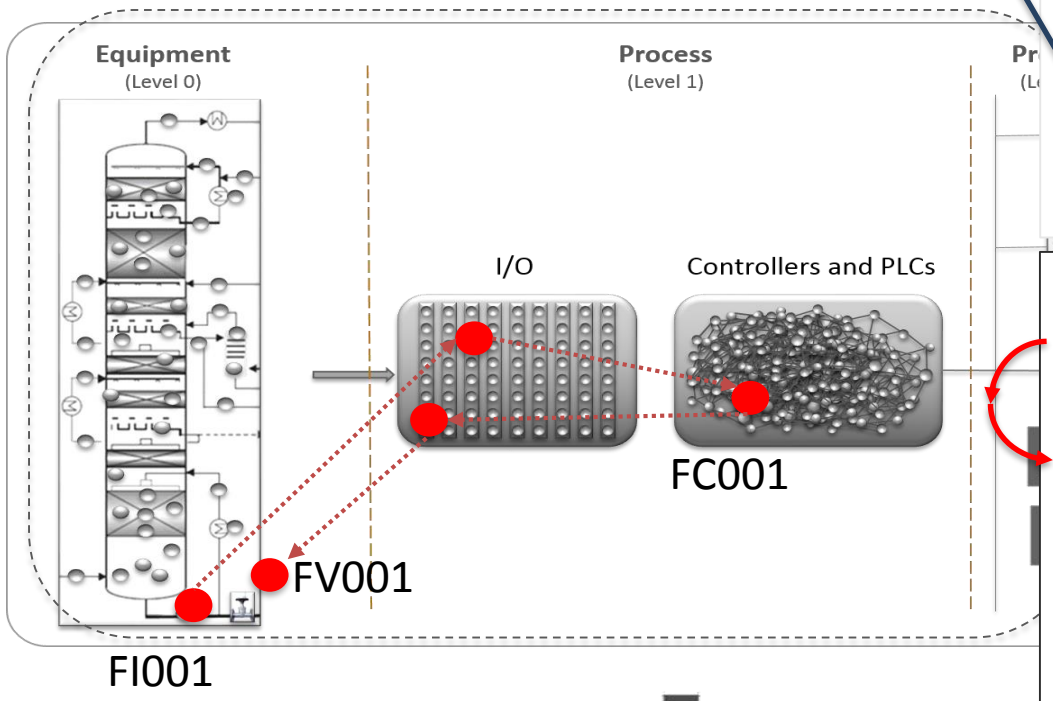
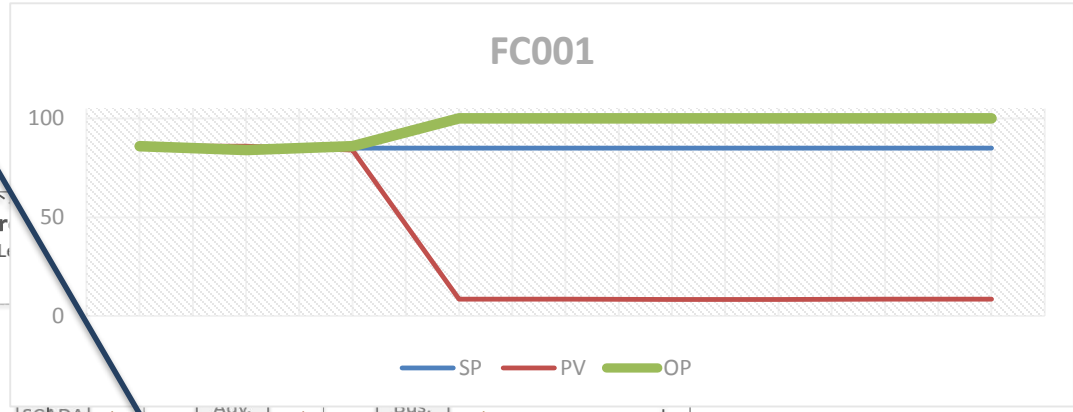
Consequences of the Change

The OP (Valve) Increases to try and Reach SP (Target Value) – goes from 85% to 100%





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Engineered Value

Low Range = 0 BPH (4 Milliamps)

High Range = 10 BPH (20 Milliamps)

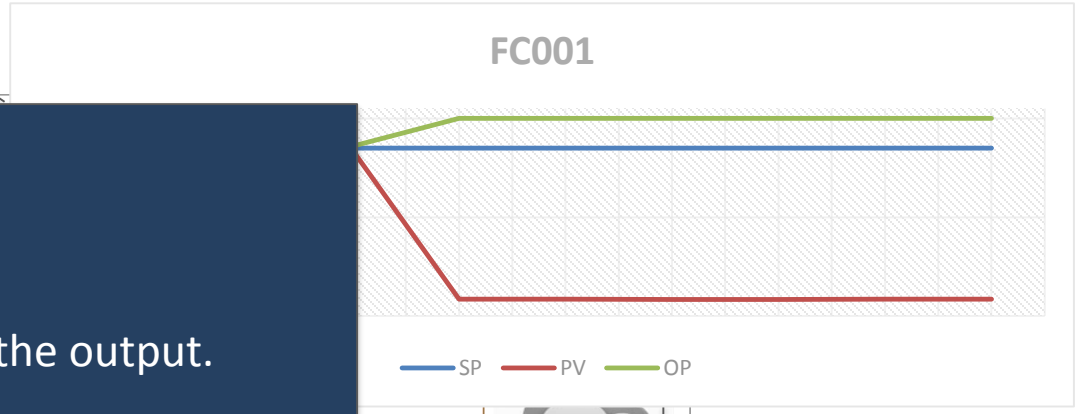
Impact Summary – Confusion & Process Shuts Down

Operator Confusion

- Why is the valve at 100%?
- Why is there no alarm?
- If caught quickly - place the valve in manual and control the output.
- If not caught quickly - unit shuts down (hopefully safely)

Engineer Confusion

- How could the PID Integral change form .2 to .3 result in this behavior?
- There is no record of the Malicious change as a result the issue will most likely get classified as an inadvertent change



s:

PH (Target Value)

BPH (Actual Value) (17.6 Milliamps)

% (Valve % Open)

rm

e

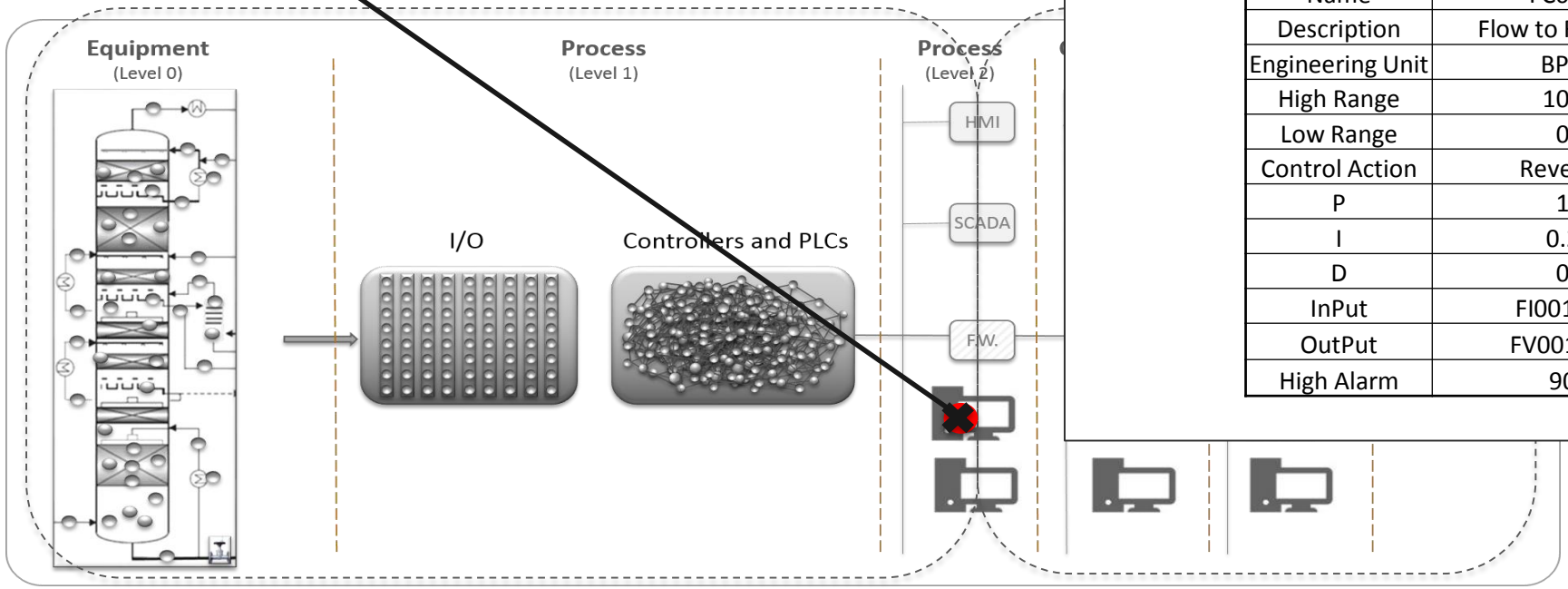
Low Range = 0 BPH (4 Milliamps)

High Range = 10 BPH (20 Milliamps)

SCENARIO 1 - DEFENDING

Defending

Monitor the offline configuration of the Control System



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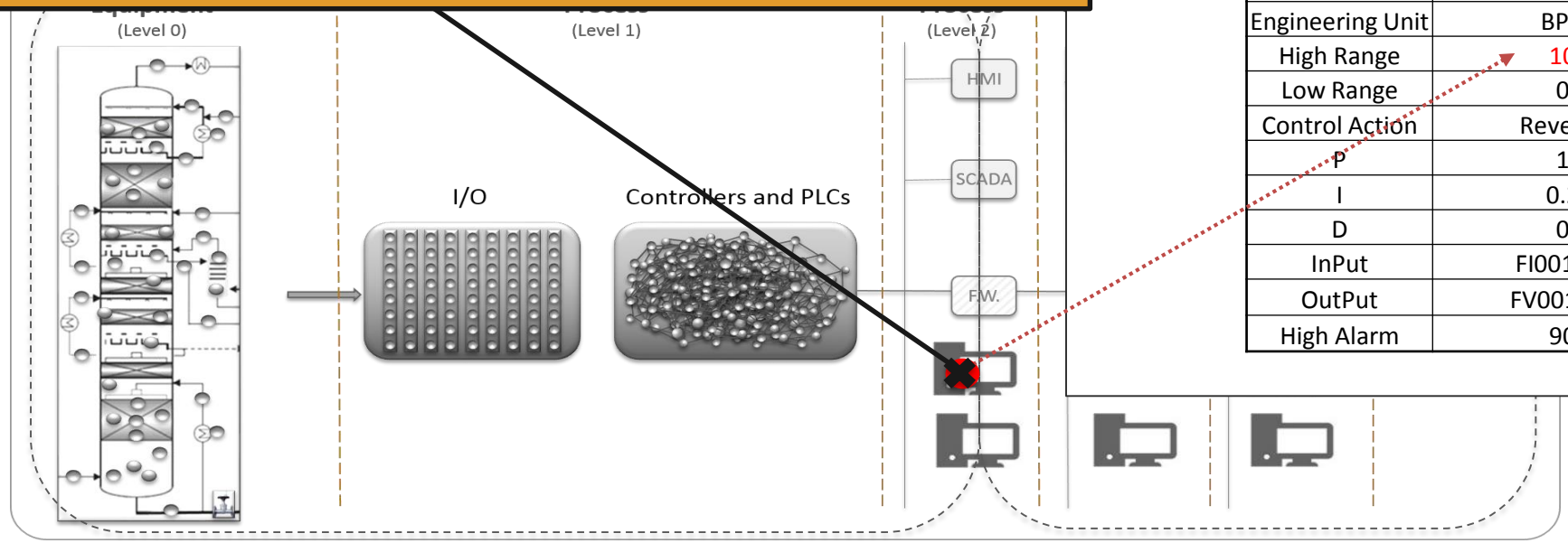
Defending

- Detect access and change within the environment.
- You must have context at this point because the configurator UI shows nicely formatted data but the actual control system config file is binary



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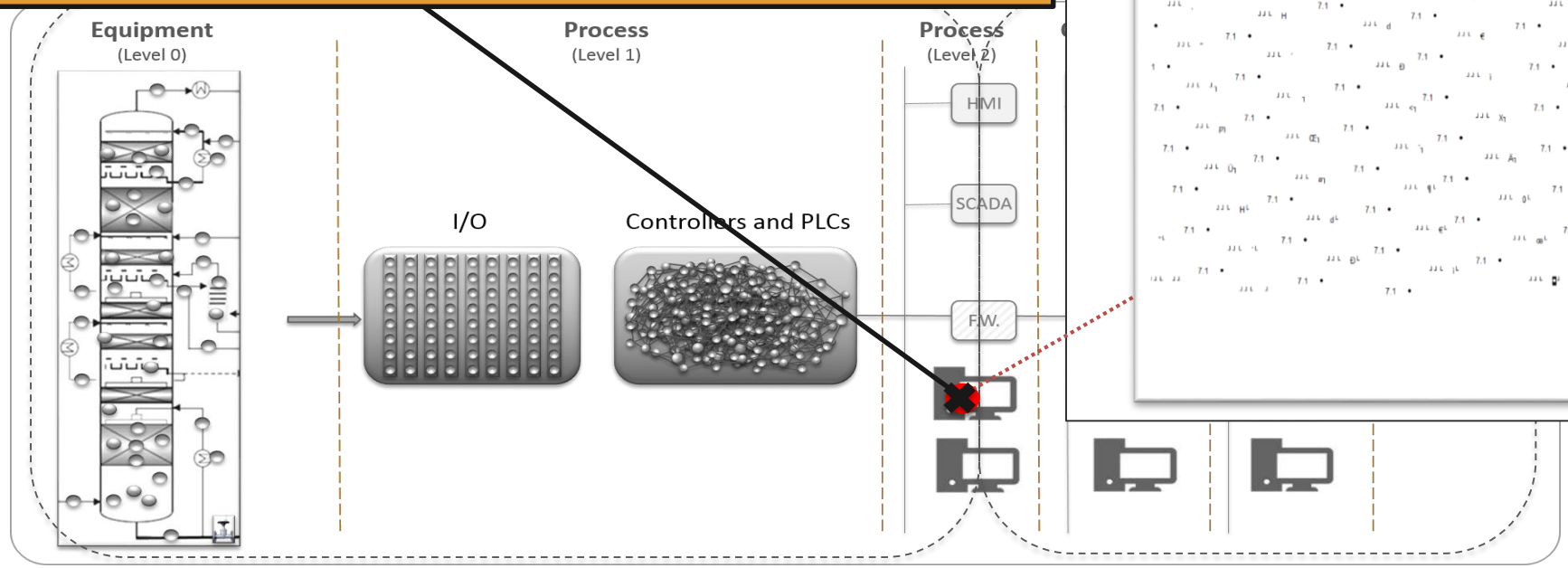
Defending

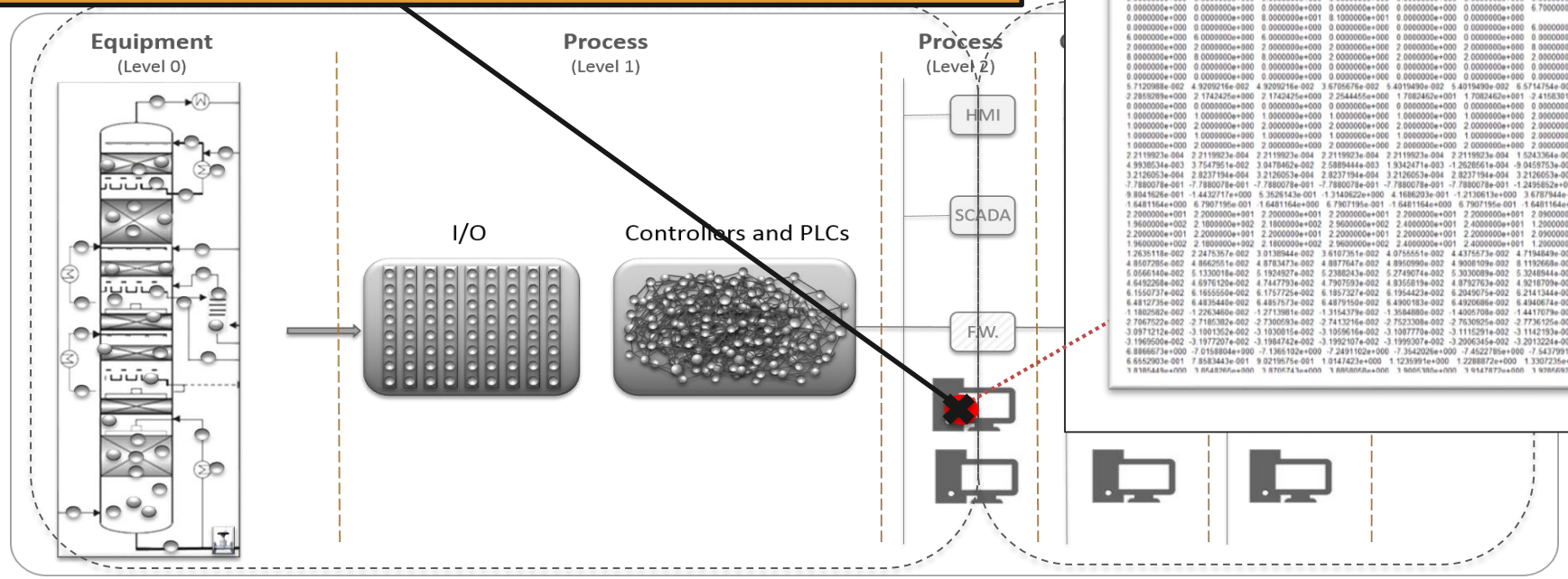
Detect Access and change within the environment - must be able to interpret binary configuration files.



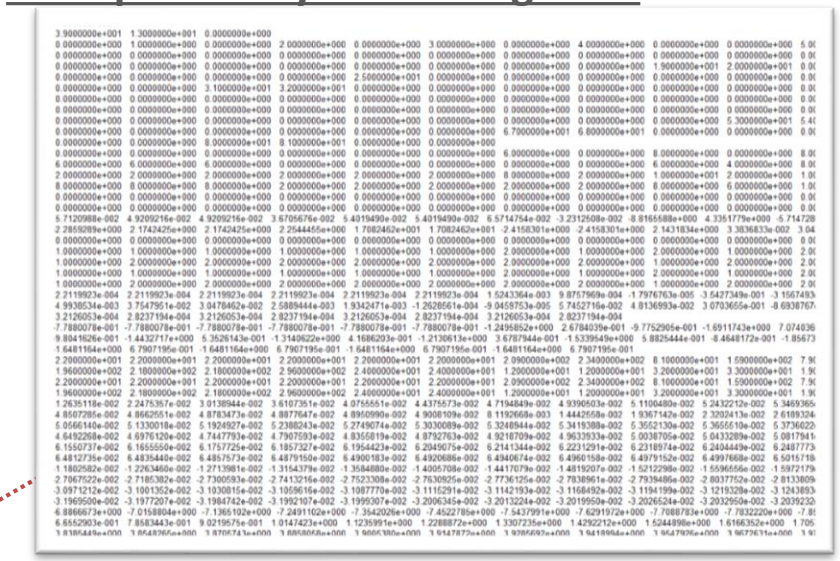
Example Yokogawa Config. File:

Defending

Detect Access and change within the environment - must be able to interpret binary configuration files.

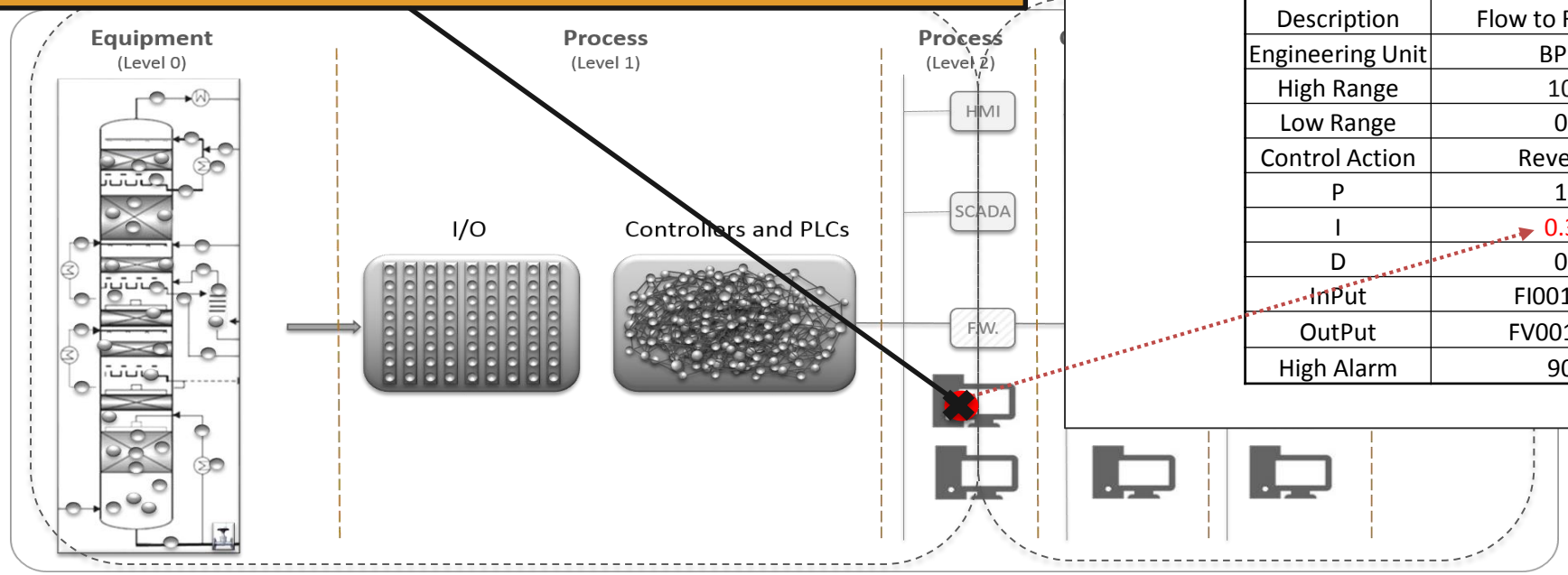


Example Honeywell Config. File:



Defending

You must have something or someone who understands what's a normal operational change compared to a potential security change



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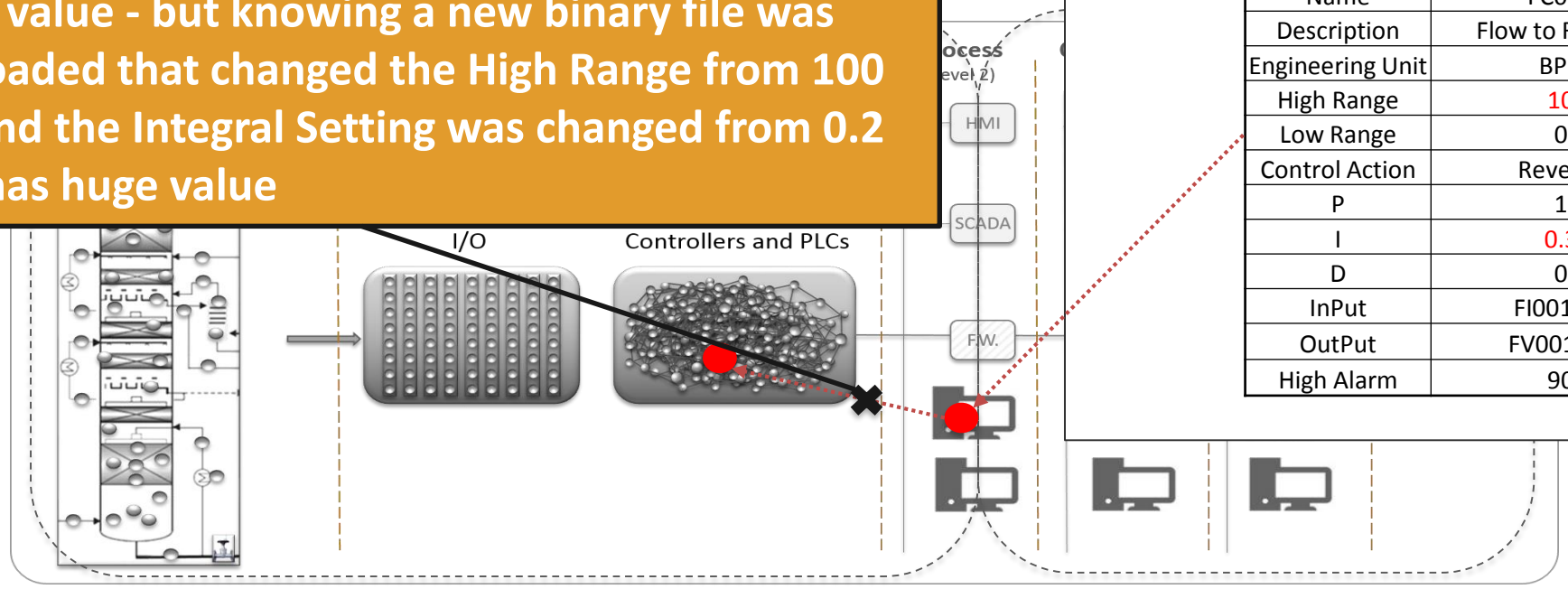
Defending

- You need to be able to detect the download event
- Its equally important to understand the context of what's being downloaded.
- Knowing a new binary file was downloaded has limited value - but knowing a new binary file was downloaded that changed the High Range from 100 to 10 and the Integral Setting was changed from 0.2 to 0.3 has huge value



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P	1
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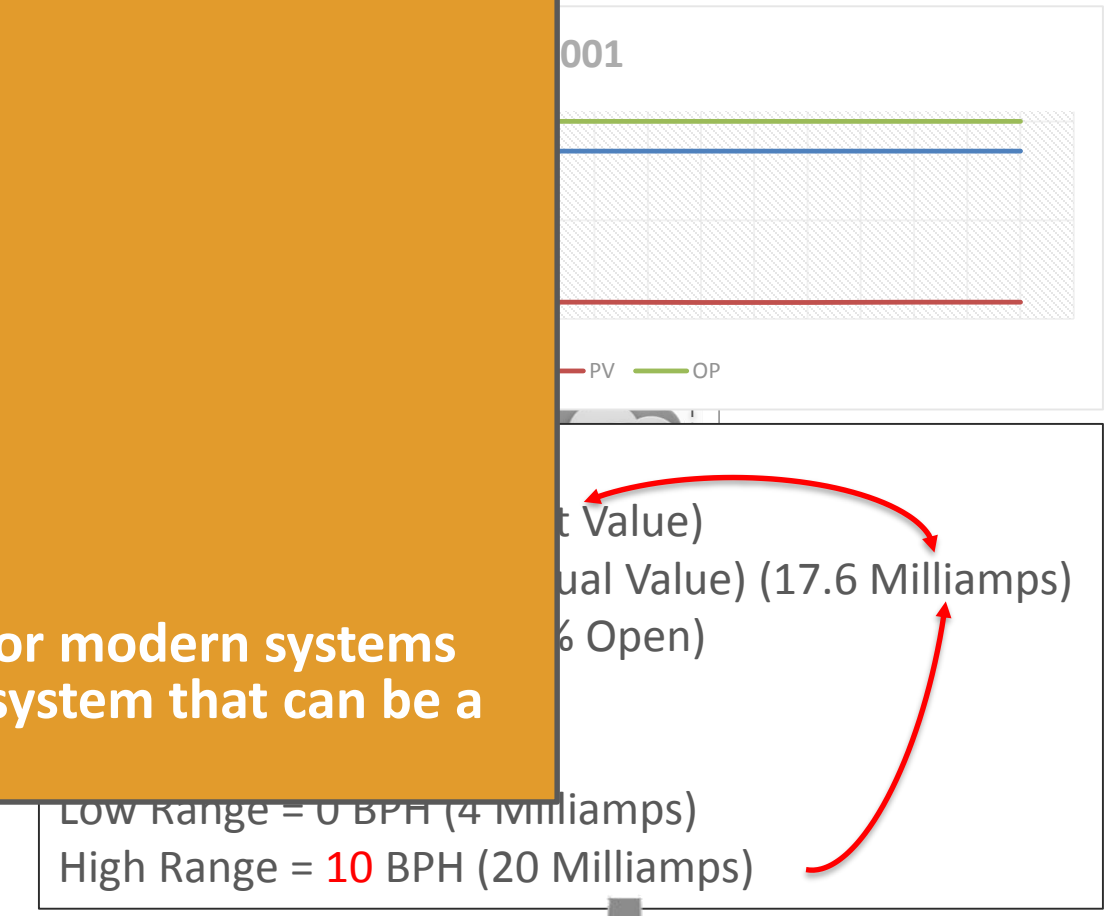
Defending – Summary Actions to Take

You need:

- A tool that allows you access to forensic details:
  - Online Changes
  - Offline Changes
  - Events
    - Application
    - Security
    - System Events
    - Operator Actions
    - Process Alarms
  - Normal Behavior compared to Abnormal Behavior
- Access to Restore Points to Revert the Change - for modern systems that's an easier problem to solve, but for legacy system that can be a challenging problem

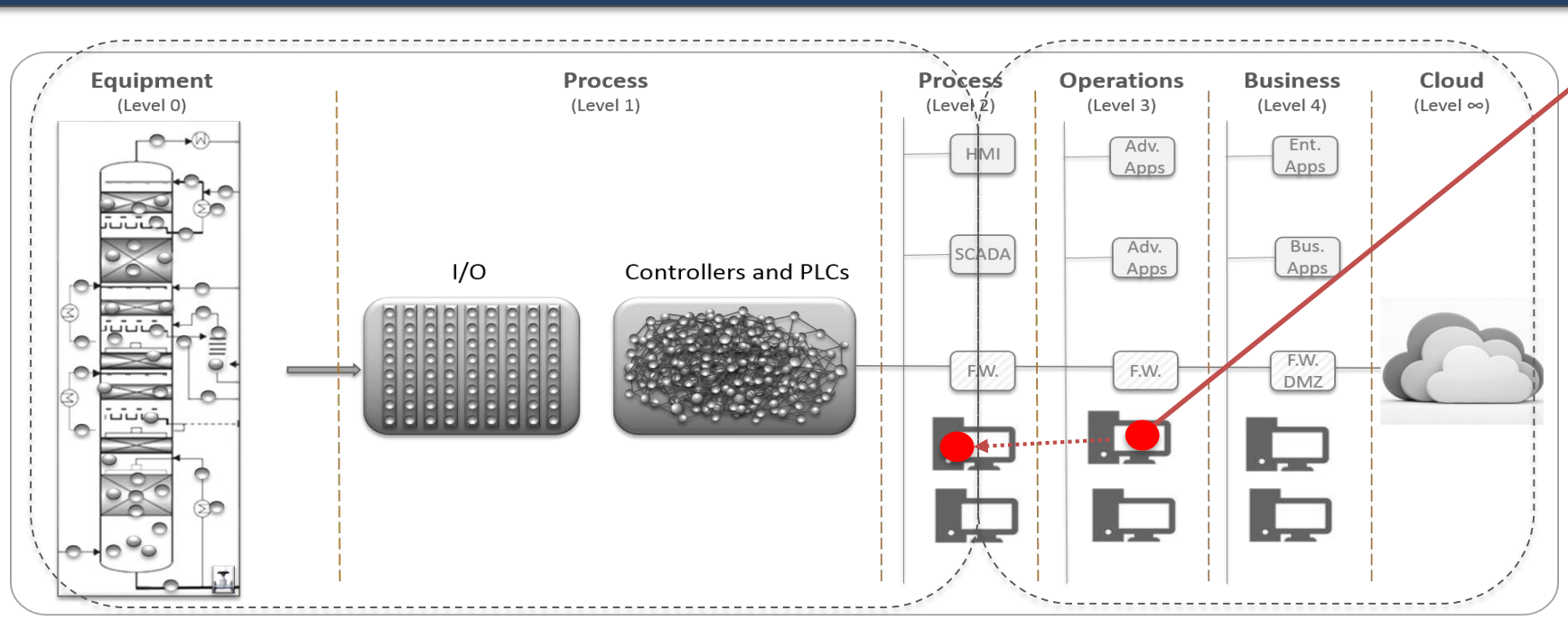


Thank You

Scenario 2 – Privileged Remote User

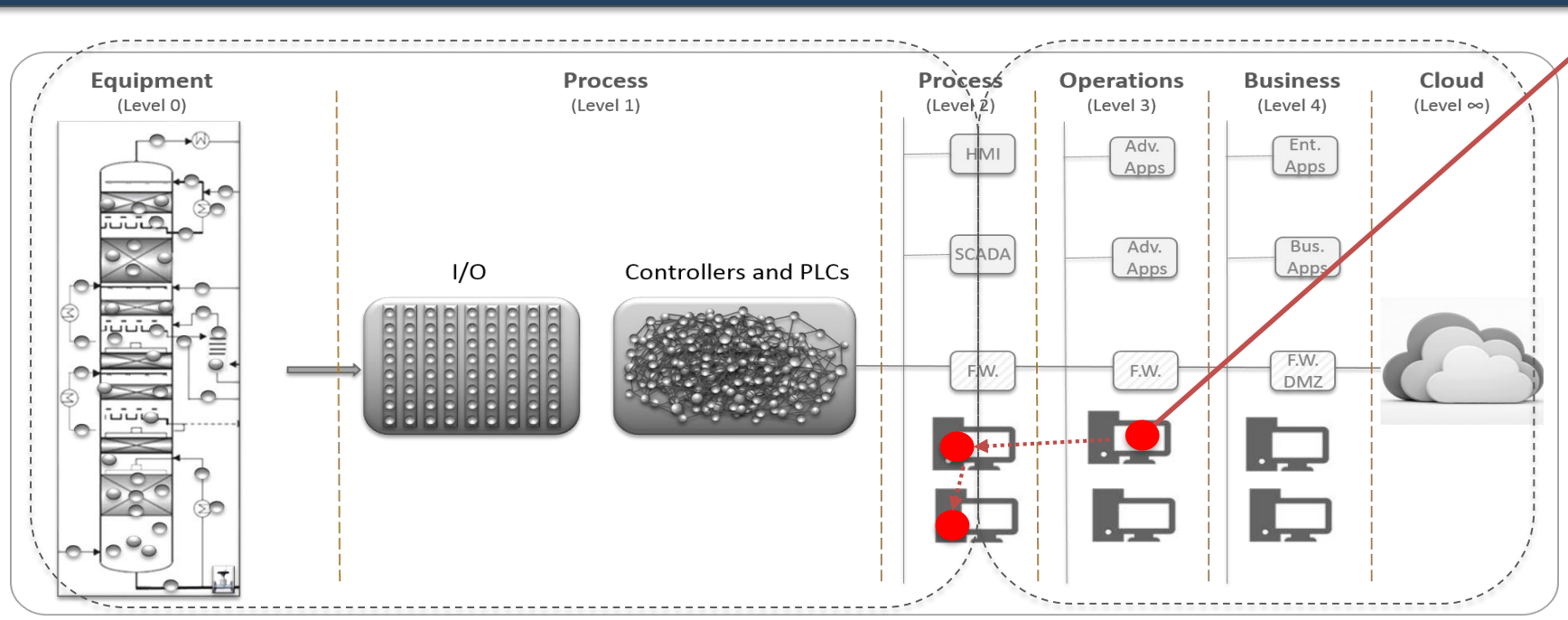
Malicious/Inadvertent Action by Privileged Remote User

Accesses an engineering station and makes malicious / inadvertent change



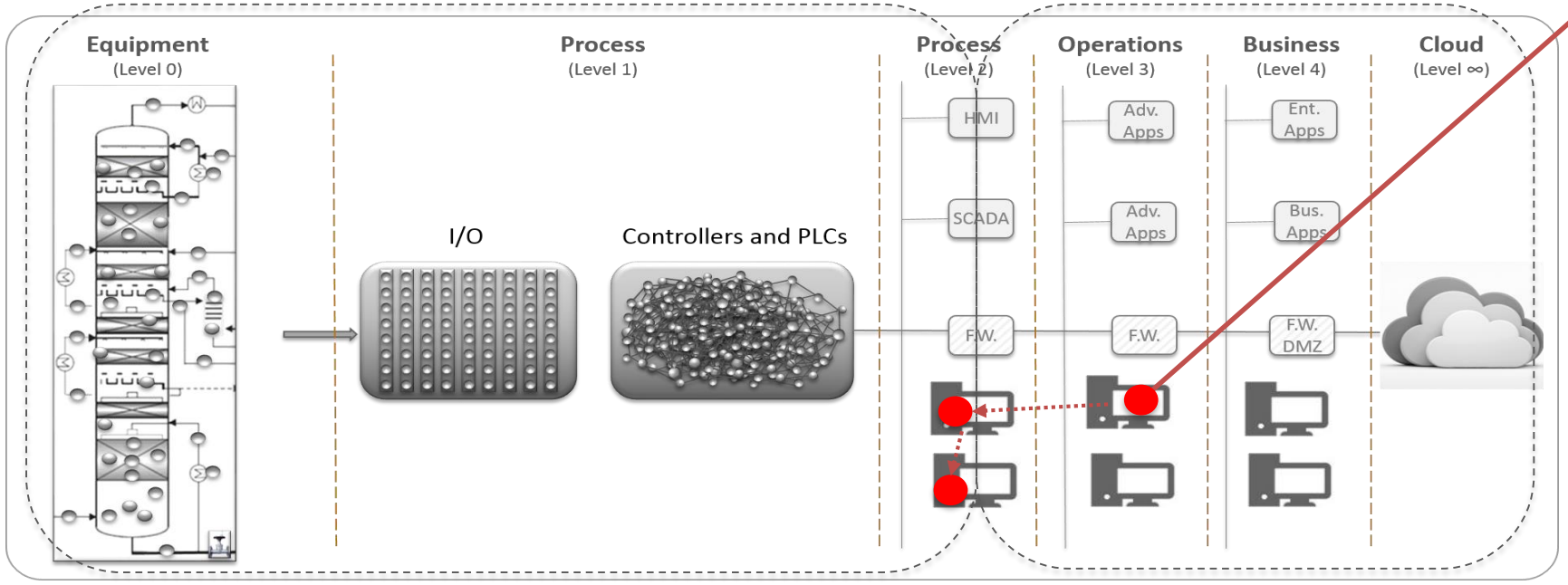
Action 1 – Remote User Deletes Backups to Impact Recovery

Deletes Backup on Remote Host (Assuming Malicious)



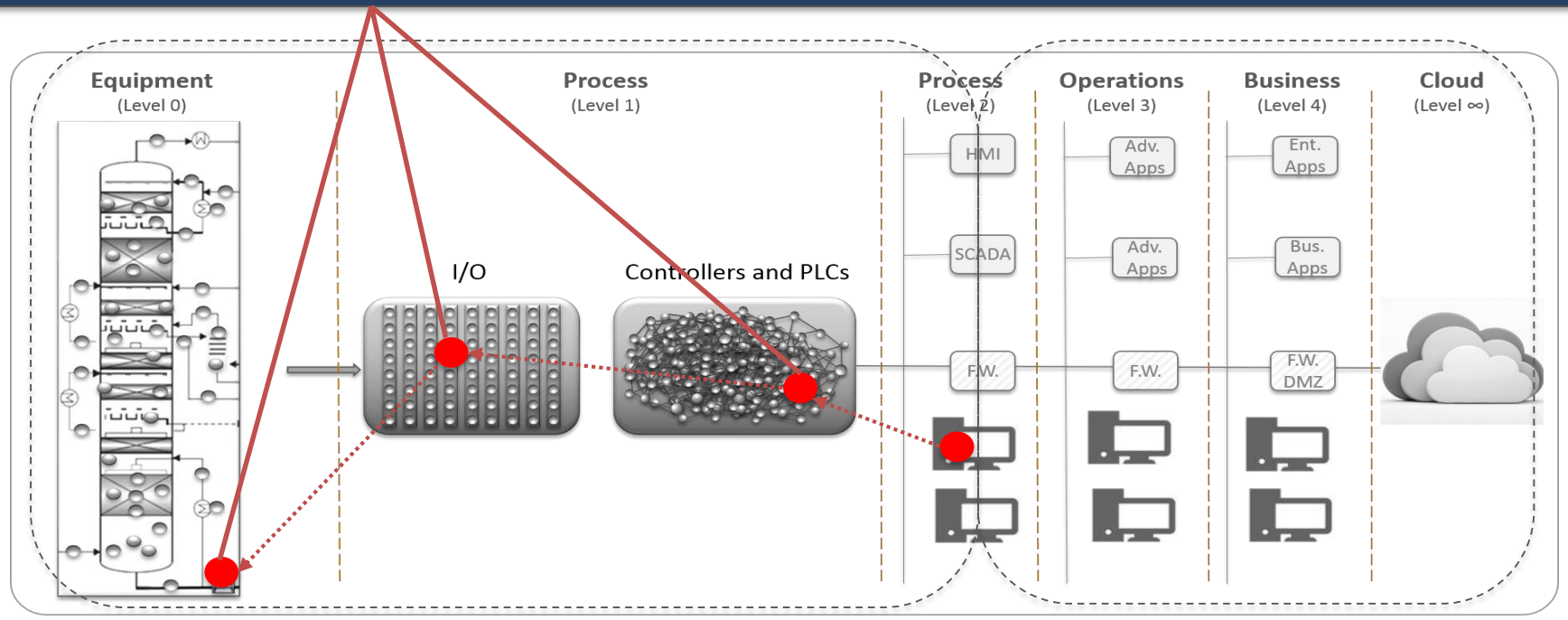
Action 2 – Remote User Makes Malicious/Inadvertent Change(s)

Changes made - possibly to SIS project
Changes made - possibly to DCS



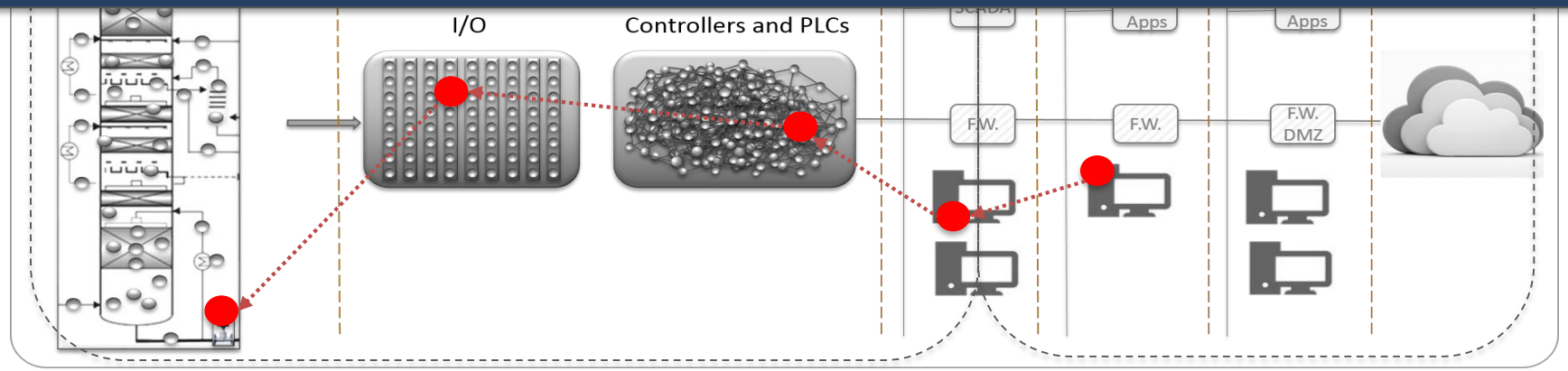
Action 3 – System Propagates Changes

Level 1 and 0 system settings are changed



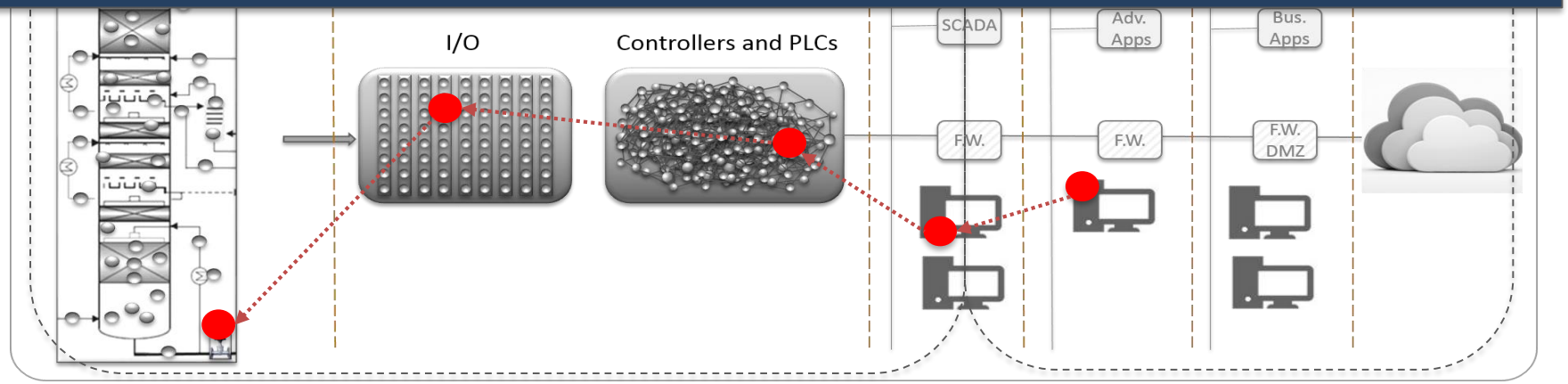
Consequences of the Change

- Plant Shuts Down (Hopefully Safely)
- Nobody Knows Why
- An Incident Investigation Occurs
    - Hours turns to days, days turns to weeks and the plant isn't making money
    - Eventually the actions that caused this events are understood (enough); system is re-engineered, tested, and re-started



Impact Summary – Confusion & Process Shuts Down

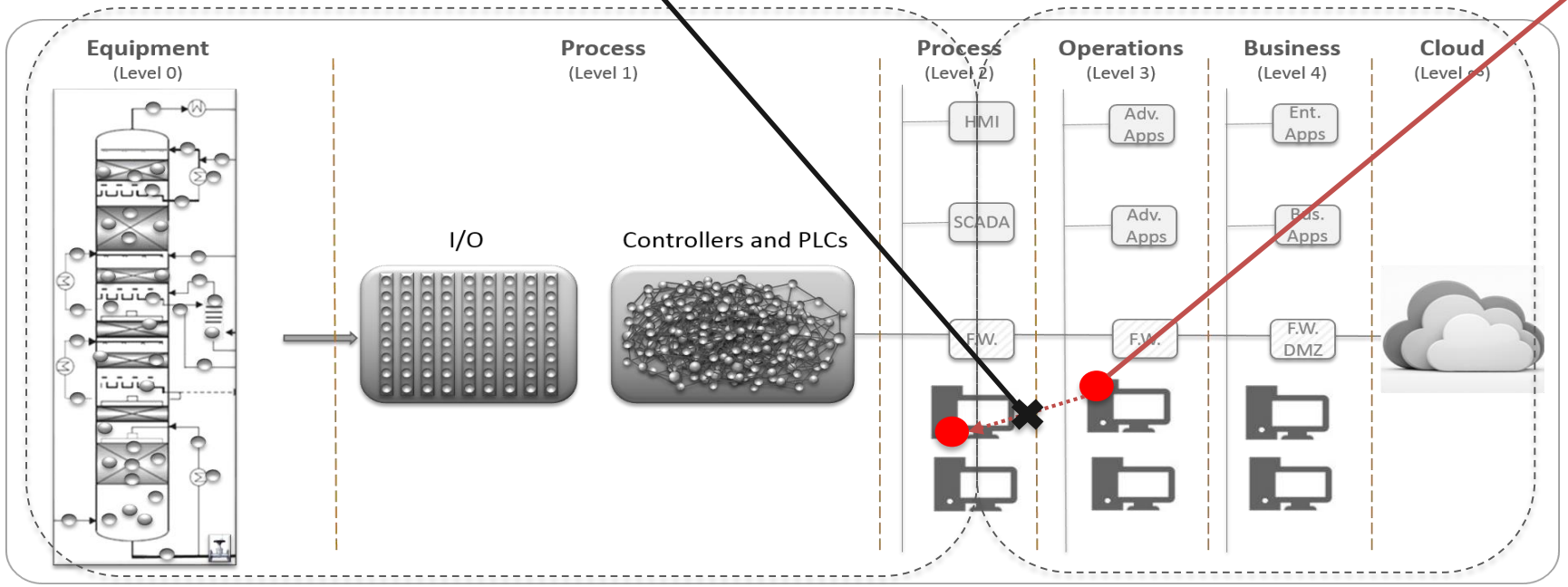
- Millions of revenue lost
- Hundreds of man-hours wasted
- Increased risk to safety
- Potential impacts to good neighbor relations



SCENARIO 2 – DEFENDING

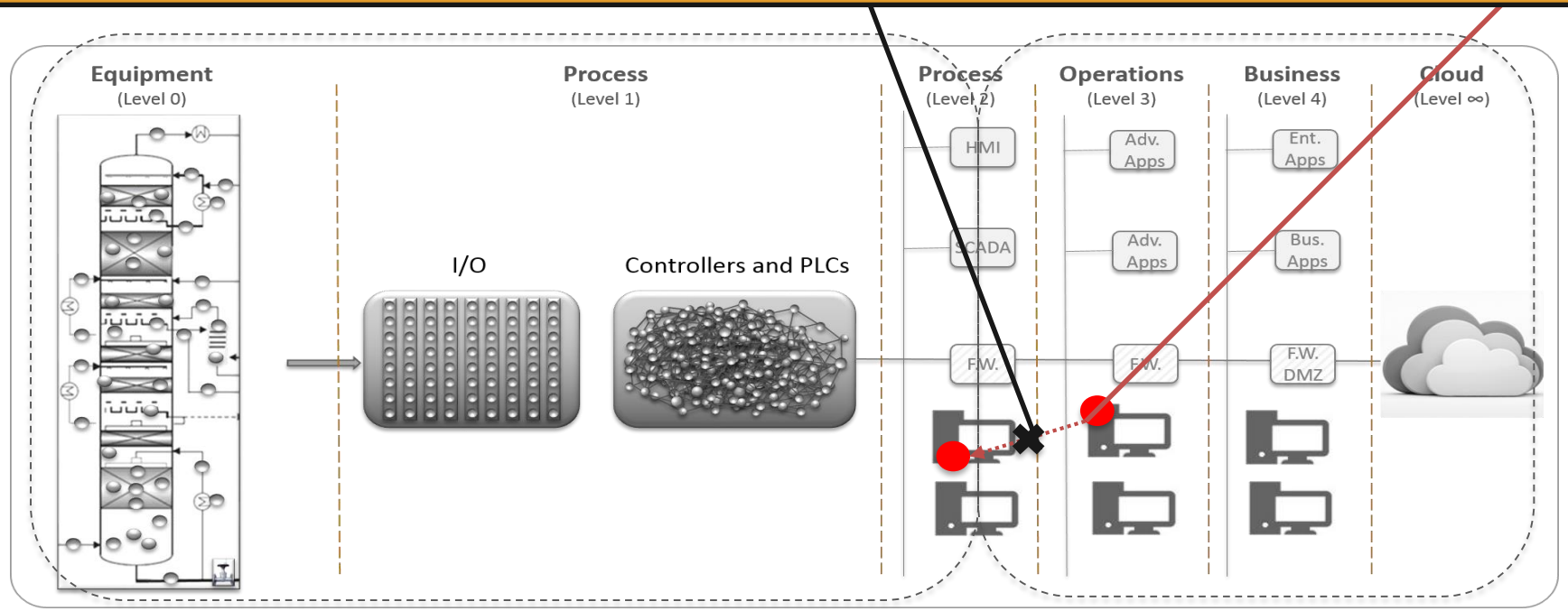
Defending

- **Monitor all communication that occurred between Remote Console and Engineering Station**



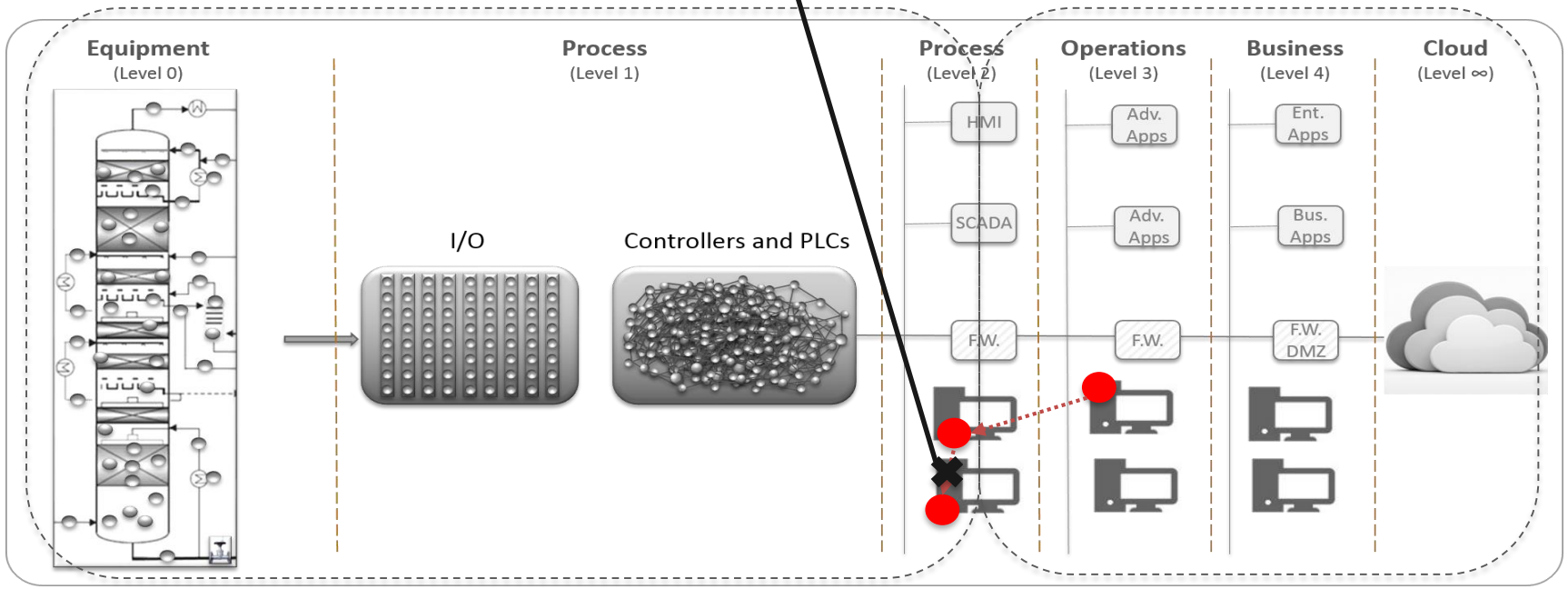
Defending

- Detect suspicious activity across your IT & OT environments
- Stop cyber-attacks in their earliest stages
- Reduce the amount of time to detect, investigate and remediate cyber threats



Defending

- **Monitor all communication that occurred between Engineering Station and other Windows stations on the Process Control Network (PCN)**



Defending

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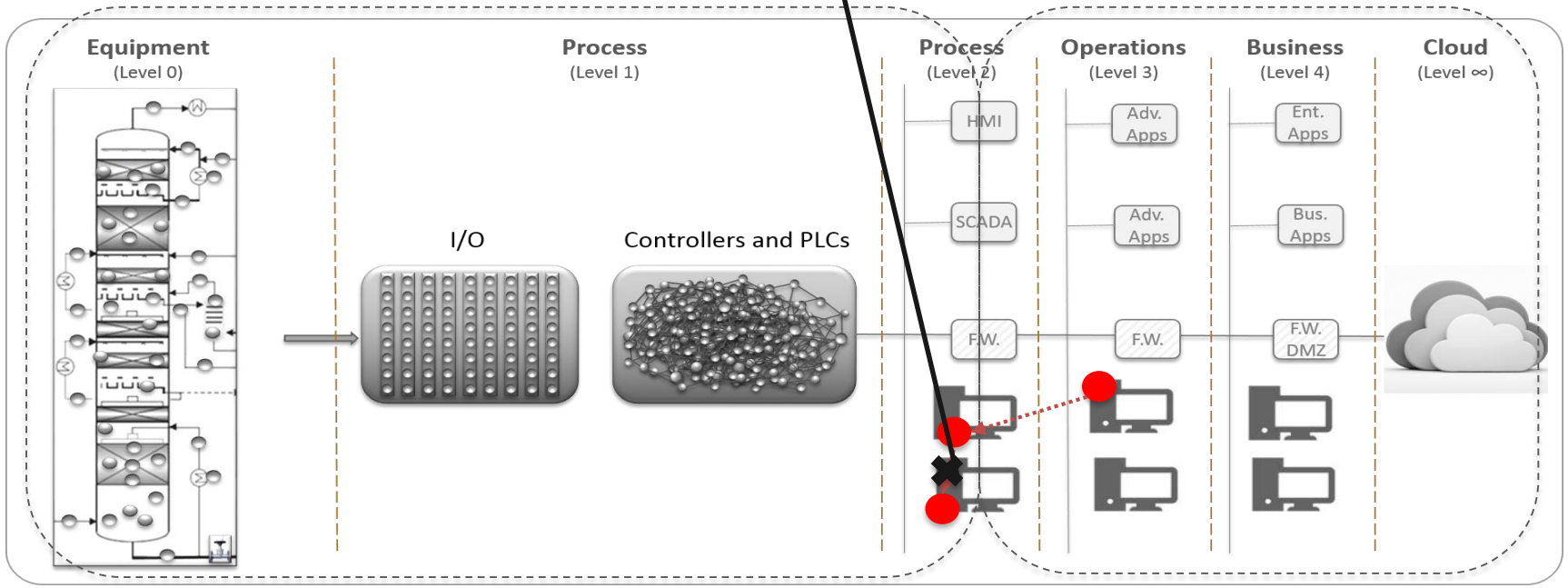
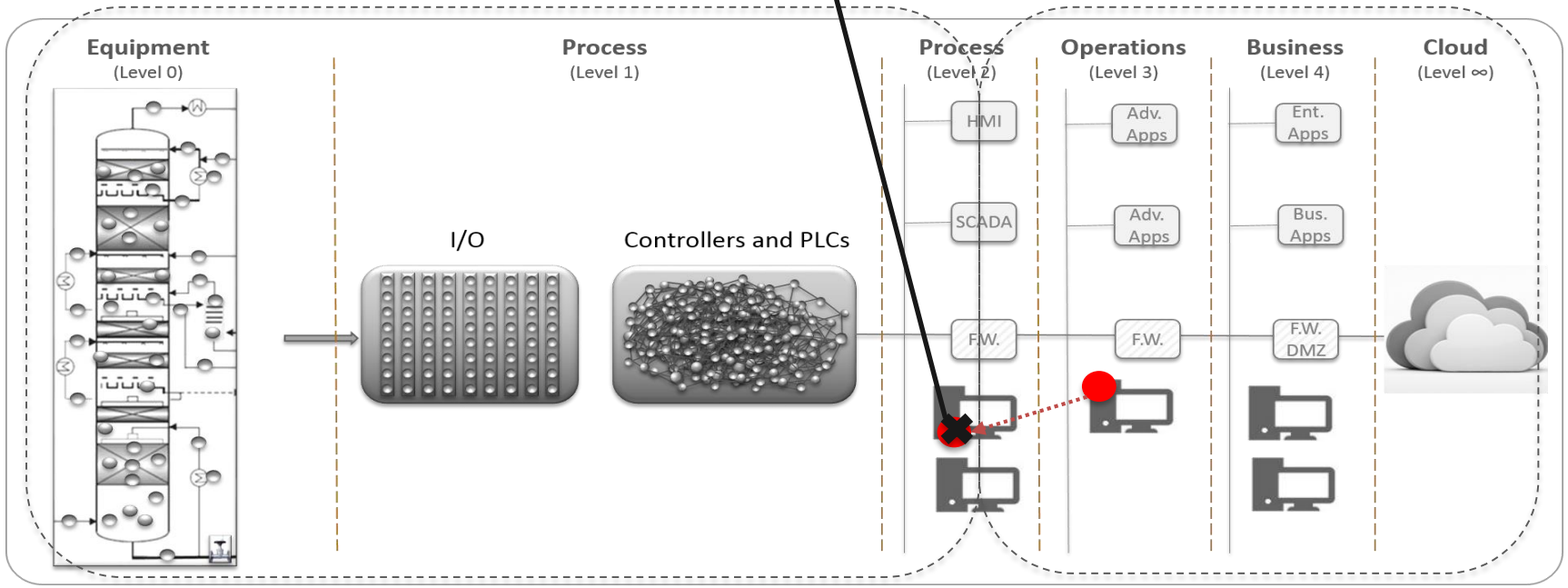


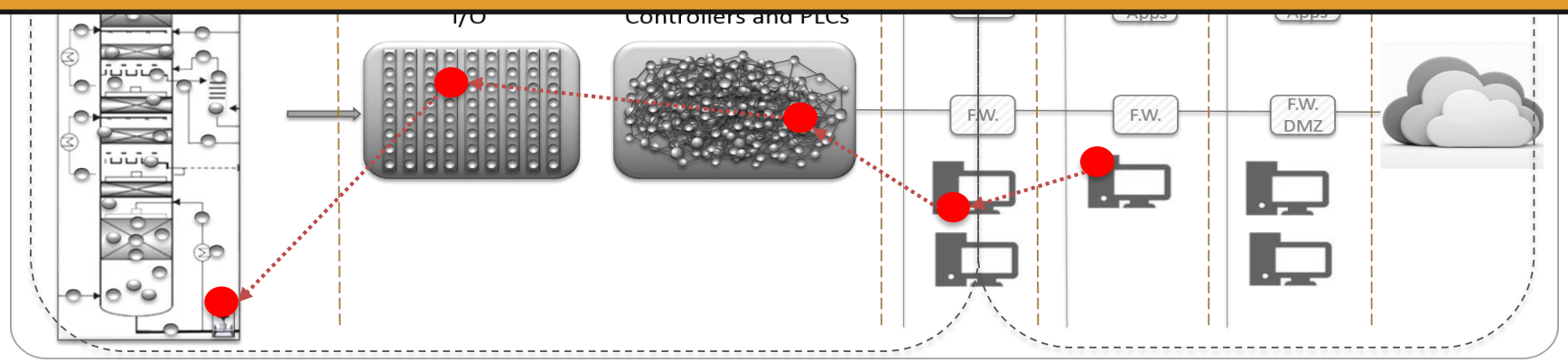
Defending

- Monitor all Operator Actions, System Events, and Process Alarms on PCN
- Monitor all offline changes made by the Engineering Configurator



Summary Actions to Take

- **You Need Tools to Help You:**
  - Detect suspicious activity across your IT & OT environments
  - Stop cyber-attacks in their earliest stages
  - Cut the cost, time and scope of cyber incident response
  - Reduce the amount of time it takes to detect, investigate and remediate cyber incident s
  - Identify the “covert channels” and command-and-control communications that indicate the presence of malware in your IT & OT environments



Thank You

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