

Advanced Applications and Process Automation

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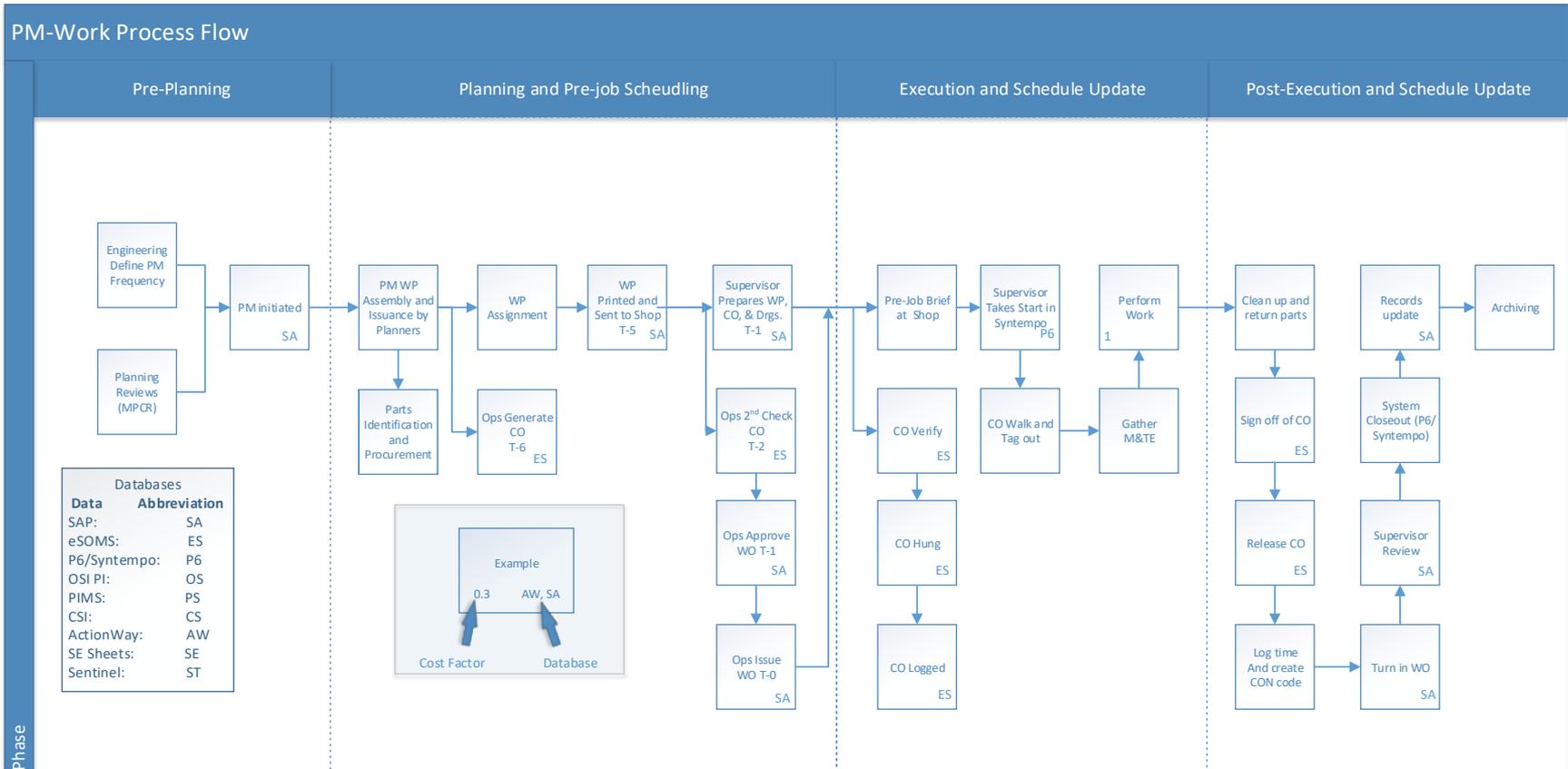


FY 2019 Work Packages

- Instrumentation and Control Infrastructure Modernization
 - Identify and resolve technical challenges associated with modernizing I&C infrastructure (new communication protocols, system interfacing, V&V of digital replacements, etc.)
- Digital Architecture for an Automated Plant
 - Data integration to support advanced work processes and plant automation (work management, procurement, scheduling, corrective action, etc.)
- Automation of the Work Process
 - New technologies to replace human actions (drones, cameras)
- Outage Risk Management Improvement
 - Technologies to automatically detect unintended system interactions directed by procedures



Identifying processes and value for automation



Digital Architecture

- Challenges:
 - Integration of data sources:
 - Readiness of data for integration
 - Coupling issues
 - Common information model
 - Developing the necessary infrastructure:
 - Data management requirements
 - Data infrastructure development decision making

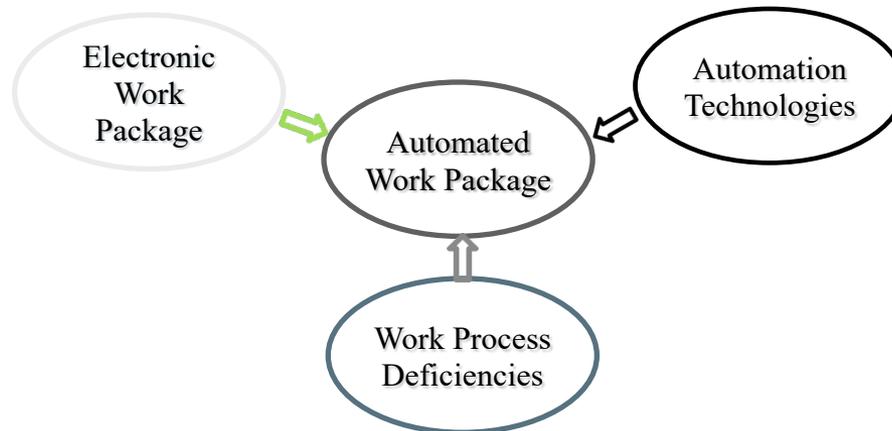
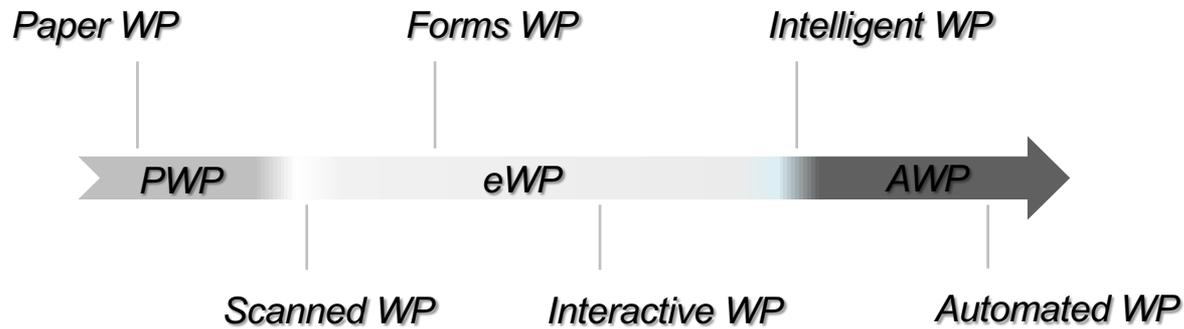


Digital Architecture

- Plans:
 - Integration of data sources:
 - Data mining methods.
 - Automated data mapping methods.
 - Requirements for a common information model.
 - Developing the necessary infrastructure:
 - Nuclear data sources specific data estimating tools.
 - Data infrastructure costing tool.



Automated Work Packages



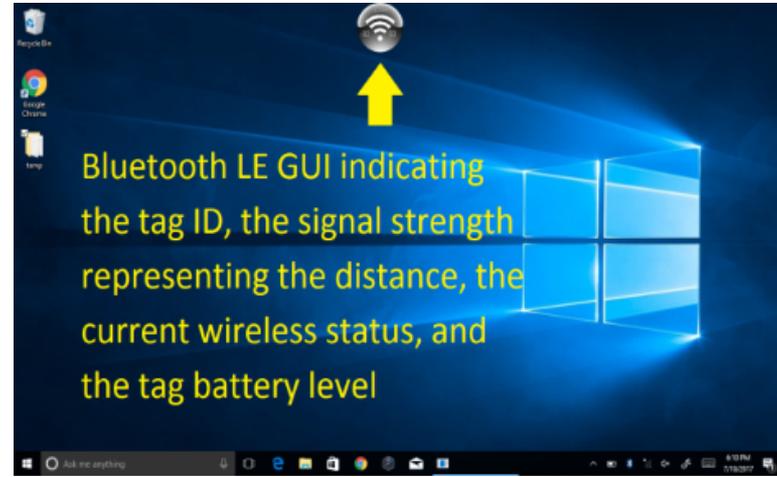
Automated Work Packages- Technologies

- Survey of automation technologies:
 - Applications
 - Cost saving
 - Maturity/readiness

Augmented Reality x	Mobile equipment evaluation tool	Video recording
Bar code	Motion recognition	Video monitoring
Drones	Plant data integration	Virtual Reality
Electronic tags	Radio frequency Identification	Wi-Fi positing
Electronic work package	Smart equipment	Wireless actuators
GPS	Smart tools	Wireless beacons
Image anomaly detection	Smart scheduling	Wireless networks
Image information extraction	Spatial mapping	Wireless sensors
Image objects recognition	Three dimensional animation	Work data mining
Interactive audio	Three dimensional printing	Work risk models
Mobile devices	Video communication tools	—



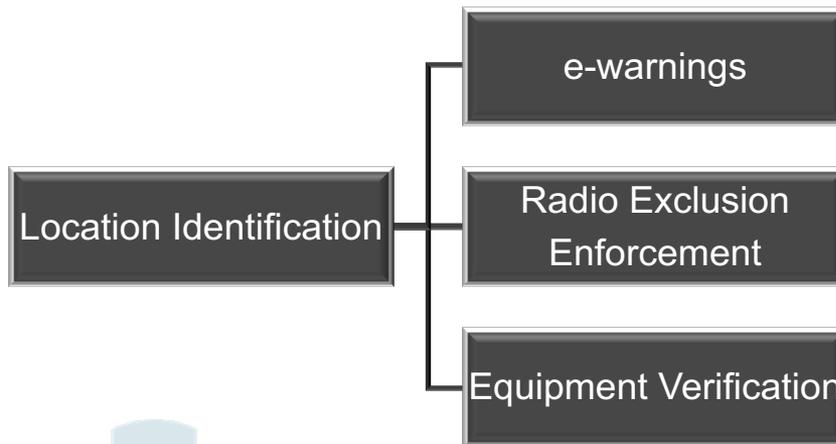
Technologies to support AWP's - Bluetooth



Technologies to support AWP's - Bluetooth

Bluetooth Low Energy Beacons

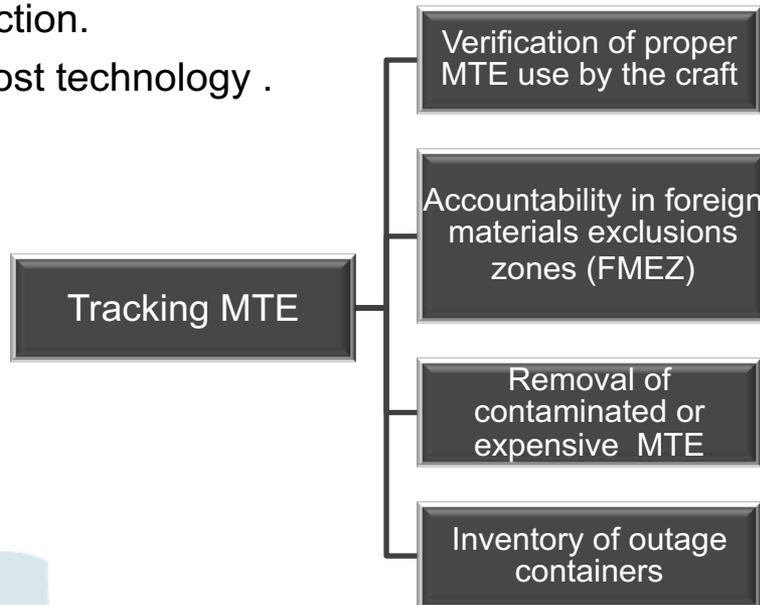
- Very compact, light, and easily attachable to walls and surfaces.
- Detected by any Bluetooth enabled device.
- Very low energy consumption.
- Inexpensive (tens of United States dollars).
- Tunable signal strength (inches to tens of feet's)



Technologies to support AWP's - RFID

Ultra High Frequency Radio Frequency Identification (UHF RFID)

- Passively powered tags.
- Various forms and sizes of tags .
- Various types of readers power method and antennas connection.
- Low-cost technology .



RFID utilization and evaluation



Select All
 Unselect All

➔

Select All
 Unselect All

➔

Select All
 Unselect All

Log In List

Ind.	Hts	Pres./%	ID	Description
0	34	100%	2016 1209 0851 BA01 1040 00C7	Screw driver Size 4
1	48	100%	0229 0300 0000 0000 0000 1708	Adjustable Wrench R/CO
10	3	0%	0000 70FC 0C09 0A1D E1F5 05A1	
11	5	0%	0004 8300 8000 0000 0000 0327	
12	4	100%	0229 0300 0000 0000 0000 170E	Tools bag
13	1	0%	3038 3382 0009 0140 0000 0300	Procedure: MV seal repla
2	87	85%	8230 9470 1039 1491 0300 5831	Wrench 3/8
5	75	100%	E180 1160 6000 0205 0205 825D	Multimeter FLUKE 80K2
4	27	100%	2016 0426 8511 8300 0102 0300	Wrench 7/8
5	1	100%	2016 0408 1083 SA01 1020 032F	Saw small
6	13	0%	2016 0425 0878 5402 1030 04E7	
7	5	0%	8283 1160 6000 0205 0605 82ND	

Update List

Ind.	Hts	Pres./%	ID	Description
1	48	100%	0229 0300 0000 0000 0000 1708	Adjustable wrench R/CO
13	1	0%	3038 3382 0009 0140 0000 0300	Procedure: MV seal replacem
3	34	100%	2016 1209 0851 BA01 1040 00C7	Screw driver Size 4

Log Out List

Ind.	Hts	Pres./%	ID	Description
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Missing Items List

Ind.	Hts	Pres./%	ID	Description
0600 0000 0000 0000 0040 2989				Hammer Low Force

Unassociated Items List

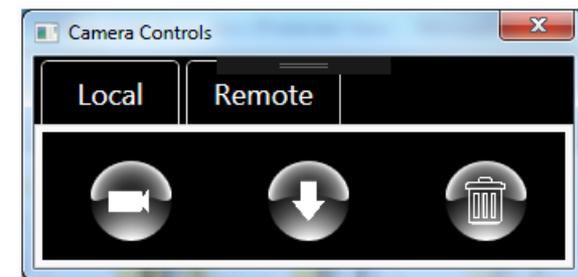
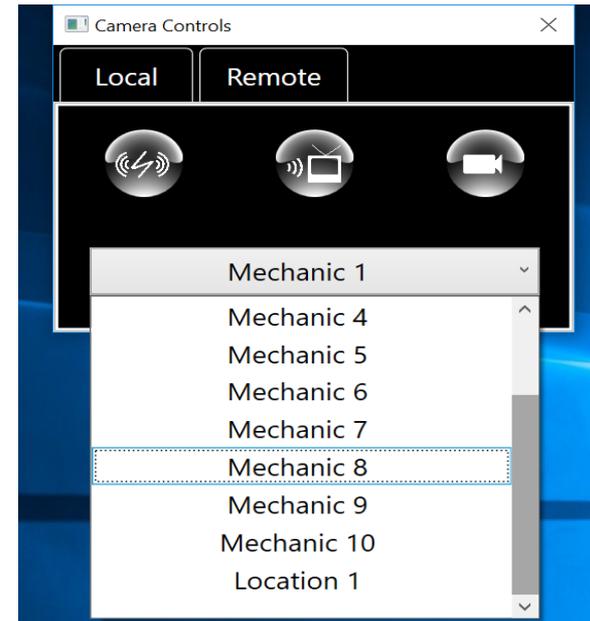
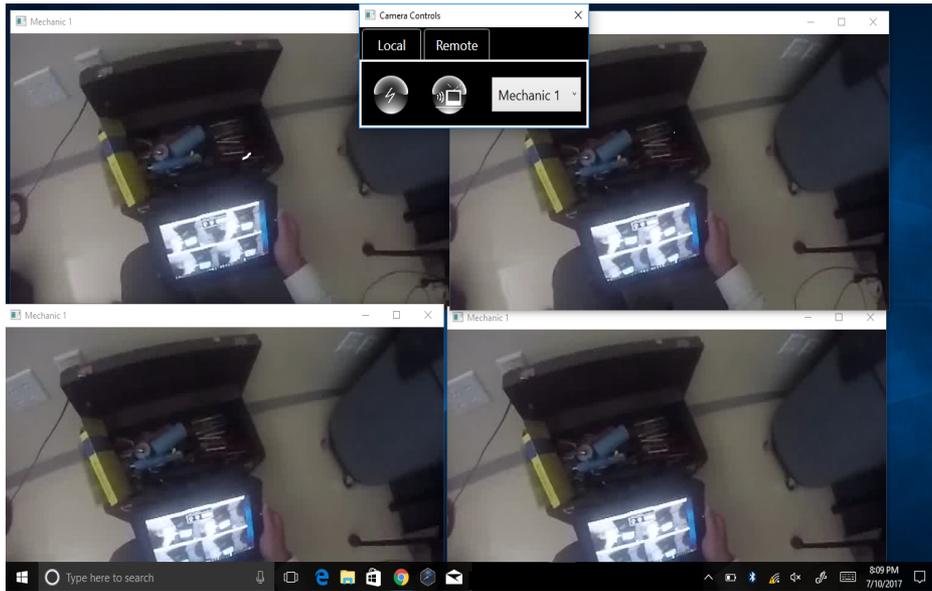
Ind.	Hts	Pres./%	ID	Description
3	34	100%	2016 1209 0851 BA01 1040 00C7	Screw driver Size 4
1	48	100%	0229 0300 0000 0000 0000 1708	Adjustable wrench R/CO
10	3	0%	0000 70FC 0C09 0A1D E1F5 05A1	
11	3	0%	0004 8300 8000 0000 0000 0327	
12	4	100%	0229 0300 0000 0000 0000 170E	Tools bag
13	1	0%	3038 3382 0009 0140 0000 0300	Procedure: MV seal repla
5	75	100%	E180 1160 6000 0205 0205 825D	Multimeter FLUKE 80K2
4	27	100%	2016 0426 8511 8300 0102 0300	Wrench 7/8
5	1	100%	2016 0408 1083 SA01 1020 032F	Saw small

Procedures List

Ind.	Hts	Pres./%	ID	Description
0	Armed A/Respon		3068 3382 0009 0140 0000 0000	MV seal replacem

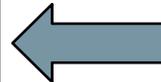
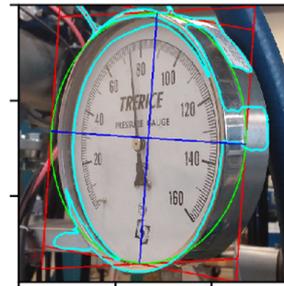
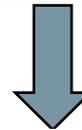


Technologies to support AWP's - Cameras



Technologies to support AWP's - Cameras

- Automation of gauges reading logging to enable a new source of data stream. Main features:
 - Using 360 cameras (low resolution)
 - At oblique angles
 - Mobile and fixed cameras



Computer Vision to monitor process bottlenecks

Controls

Begin **Quit**

Station #1

Alert Time: 30 mins

Alarm Time: 60 mins

Station #2

Alert Time: 45 mins

Alarm Time: 80 mins

Personnel

Alert Time: 15 mins

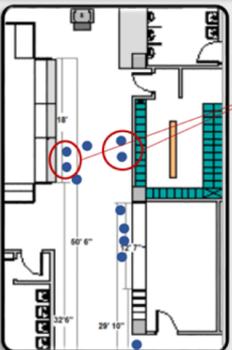
Alarm Time: 35 mins

Radiation Protection Island

Alert Time: 150 mins

Alarm Time: 250 mins

Smart Tagging:
Shows the ID,
location, and
waiting time of
a person

Use proximity analysis
to identify teams and
detect anomaly team
behaviors

Status **Average Wait Time**

Station 1 ▲ **37**

ID #	time @Station	Total time
1	3	13
2	4	1
3		

Status **Average Wait Time**

RPI ● **0**

ID #	time @RPI
1	96
2	60
3	13
4	1
5	
6	

● **0**

Use lights to
visualize the status
of each station and
the overall RPI

ID #	time @Station	Total time
1	1	64
2	2	14
3		

Technologies to support AWP's - Drones

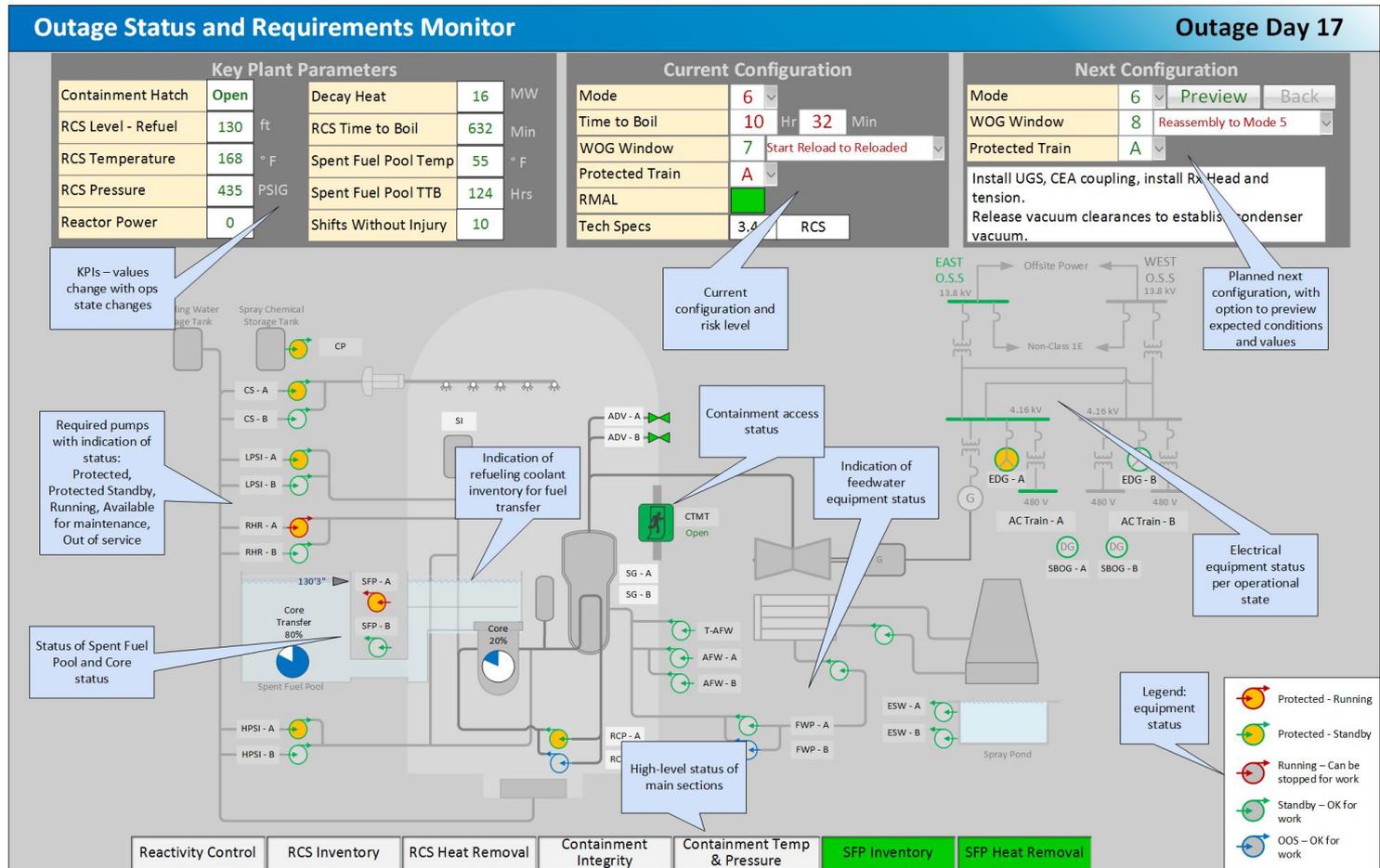
- Automation of manual inspection tasks using drones:
 - Inspections
 - Field actions
 - Material transport
 - Radiation surveys



Outage Risk Management Improvement (ORMI) Project Scope

- Improve real-time plant risk management and configuration control during outages.
- Develop a means for combining actual plant status information with intended component manipulations embedded in procedures
- Monitor technical specifications, probabilistic risk assessment information, and ongoing risk mitigation plans to identify possible interactions of concern

Outage Risk Management Improvement



OSSRM Software Application

Outage System Status and Requirements Monitor Outage Day 29

Plant Status

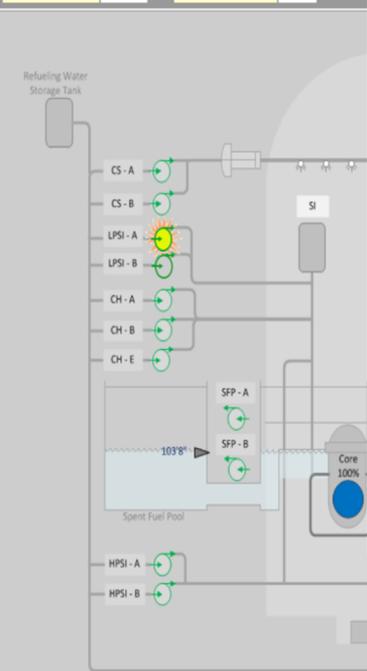
Containment Hatch	Closed	Decay Heat	16 MW
RCS Level - Refuel	2222 ft	RCS Time to Boil	532 Min
RCS Temperature	168 °F	Spend Fuel Pool Temp	55 °F
RCS Pressure	2222 PSIG	Spend Fuel Pool TTB	124 Hrs
Reactor Power	0 %	Shift Without Injury	10

Current Configuration

Mode	5
Time to Boil	10 Hr 32 Min
WOG Window	8 - Mode 5 to Mode 4
Protected Train	A

Next Configuration

Mode	1
WOG Window	8 - Mode 5 to Mode 4
Protected Train	A



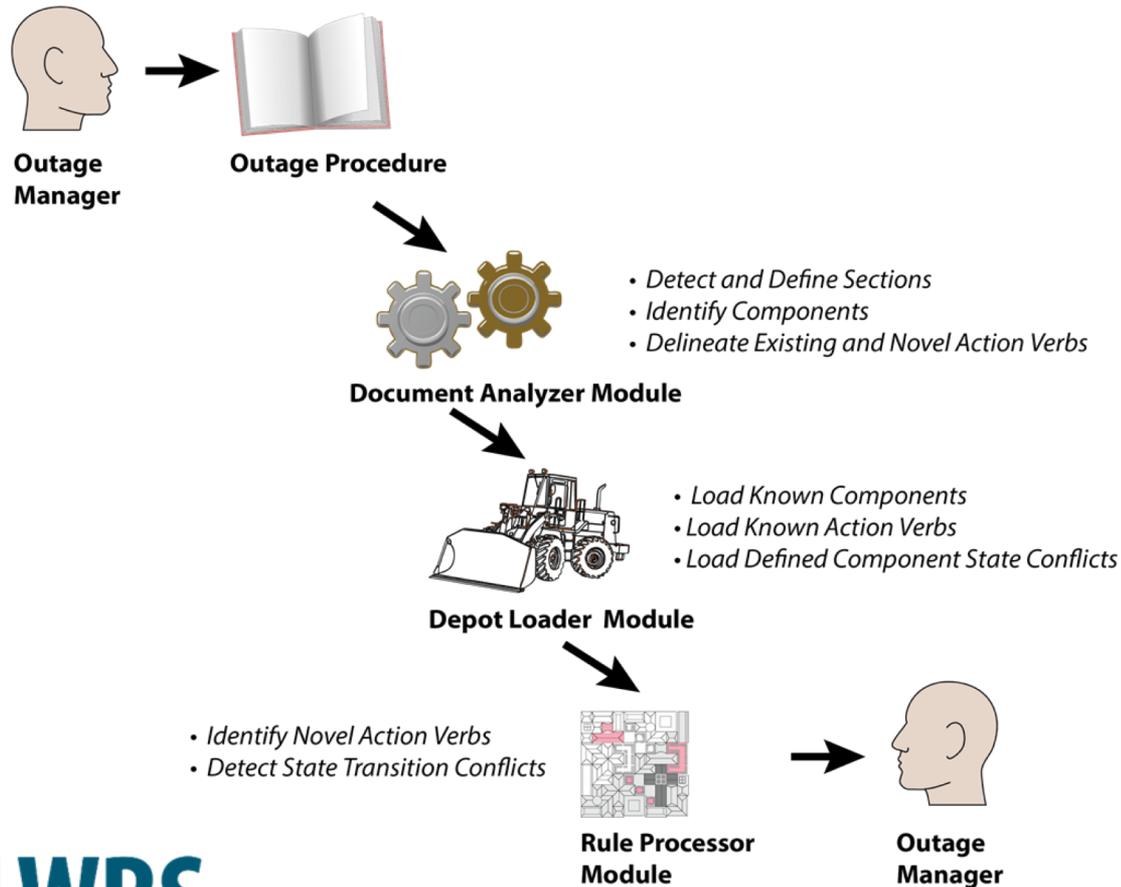
Component Detail -- LPSI A -- Webpage Dialog

Component Details for System : LPSI A

EQID	Noun Name	Component Type	Current Actual Position	Current Required Position	Current Required Status	Current Position Requirement reference
PBAS03F	SIA-P01 Power Supply Breaker	Breaker	Open	Open	Protected	Shutdown Safety Plan
SIAP01	LPSI Pump 1	Pump	Standby	Running	Protected	Plant Conditions
SIHV0306	LPSI HDR DISCHARGE ISOL TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIHV0657	SDCHE TEMP THROTTLE TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIHV0678	ISOL TO SDCHE TRAIN A	Valve	Open	Open	Protected	Plant Conditions
SIHV0683	LPSI PUMP SUCTION ISOL TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIHV0685	LPSI CROSS CONNECT TO SDCHE TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIHV0686	CROSSOVER VALVE SDCHE AND LPSI HDR TRAIN A	Valve	Open	Any	Protected	Plant Conditions
SIHV0691	SHUTDOWN COOLING WARMUP BYPASS CTMT ISOL	Valve	Closed	Any	Protected	Plant Conditions

Reactivity Control
RCS Inventory
RCS Heat Removal
Containment Integrity
Containment Temp & Pressure
SFP Inventory
SFP Heat Removal

Outage Risk Management Improvement – Natural Language Processing





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