

# A Tool To Support Improved Outage Risk Management



PSAM 14  
Shawn St. Germain  
Jacques Hugo  
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Light Water Reactor Sustainability R&D Program



# 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



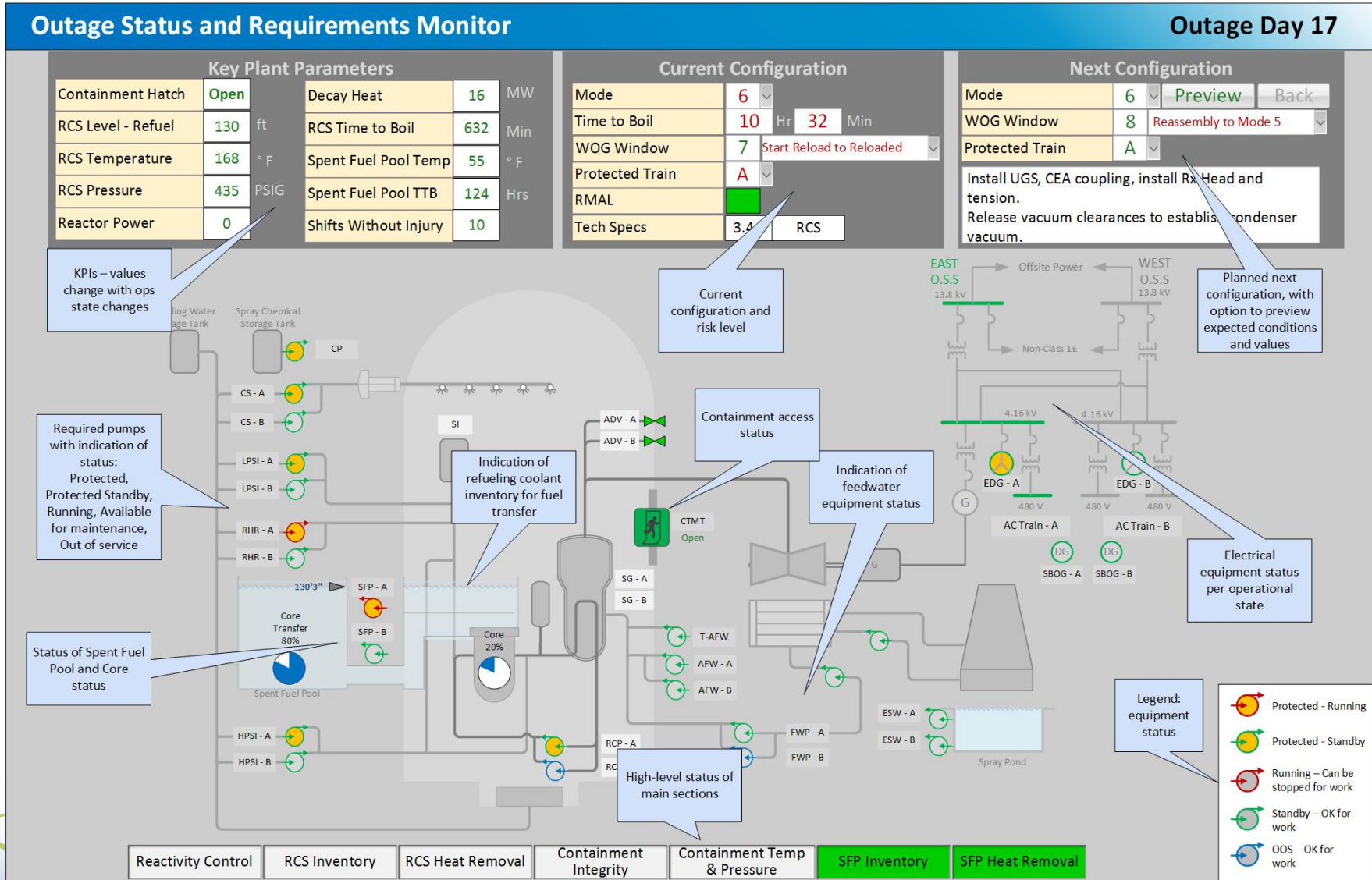
# Licensee Event Report Review

- Reviewed LERs during shutdown between 2010 and 2015 (421 LERs)
- Of these, 248 outage execution related, of those 113 identified as preventable

High Level Cause	Number of LERs noted
Configuration Control	26
Inadequate Procedures/ Procedure Use	66
Mode Change Issues	13
Poor Work Practices	11
Component Verification or Manipulation	6
Clearance Order Issues	5



# Outage Status and System Requirements



# OSSRM Software Application

**Outage System Status and Requirements Monitor** Outage Day 29

Plant Status				Current Configuration				Next Configuration					
Containment Hatch	Open	Decay Heat	16 MW	Mode	5	WOG Window	8 - Mode 5 to Mode 4	Mode	1	WOG Window	8 - Mode 5 to Mode 4	Protected Train	A
RCS Level - Refuel	2222 ft	RCS Time to Boil	532 Min	Time to Boil	10 Hr 32 Min	Protected Train	A	RMAL		Tech Spec	3.4.1 RCS		
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										

The schematic diagram illustrates the reactor system's components and their interconnections. Key elements include the Refueling Water Storage Tank, Core (100%), Spent Fuel Pool (103'8"), and various pumps (SFP, HPSI, RCP, FWP, ESW). The system is connected to offsite power (EAST and WEST O.S.S. at 13.8 kV) and a 4.16 kV bus, which feeds two AC trains (A and B) at 480 V. Other components shown include ADV, CTMT, SG, AF, and a Spray Pond.

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

# 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	Edit	

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

Refueling Water Storage Tank

CS - A, CS - B, LPSI - A, LPSI - B, CH - A, CH - B, CH - E

SFP - A, SFP - B

Core 100%

Spent Fuel Pool

HPSI - A, HPSI - B

RCP - ZA, RCP - 2B, FWP - A, FWP - B, ESW - B

Spray Pond

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
SIA01	LPSI Pump 1	Pump	Standby	Running	Protected	Plant Conditions
SIAHV0306	LPSI HDR DISCHARGE ISOL TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIAHV0657	SDCHE TEMP THROTTLE TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIAHV0678	ISOL TO SDCHE TRAIN A	Valve	Open	Open	Protected	Plant Conditions
SIAHV0683	LPSI PUMP SUCTION ISOL TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIAHV0685	LPSI CROSS CONNECT TO SDCHE TRAIN A	Valve	Closed	Closed	Protected	Plant Conditions
SIAHV0686	CROSSOVER VALVE SDCHE AND LPSI HDR TRAIN A	Valve	Open	Any	Protected	Plant Conditions
SIAHV0691	SHUTDOWN COOLING WARMUP BYPASS CTMT ISOL TRAIN A	Valve	Closed	Any	Protected	Plant Conditions

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RCS Level - Refuel	2222 ft	RCS Time to Boil	532 Min	WOG Window	8 - Mode 5 to Mode 4	Protected Train	A	Protected Train	A	Edit			
RCS Temperature	168 °F	Spend Fuel Pool Temp	55 °F	RMAL									
RCS Pressure	2222 PSIG	Spend Fuel Pool TTB	124 Hrs	Tech Spec	3.4.1 RCS								
Reactor Power	0 %	Shift Without Injury	10										

Preview

Apply Cancel

The schematic diagram illustrates the reactor system's components and their interconnections. Key elements include:

- Refueling Water Storage Tank** and **Spent Fuel Pool** (1038")
- Core 100%** and **CTMT** (Core Thermal Monitoring and Test)
- AC Trains A and B** (4.16 kV, 480 V)
- ESW (Emergency Spray Water) A and B** connected to a **Spray Pond**
- WOG (Work Order) Windows** and **Protected Trains** for configuration management



- Reactivity Control
- RCS Inventory
- RCS Heat Removal
- Containment Integrity
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- SFP Inventory
- SFP Heat Removal

# Example data structure

ID	EQID	Noun Name	System	Component Type	Current Actual Position	Current Required Position	Current Required Status	Current Position Requirement reference	Next Operating State Required Position	Next Operating State Required Status	Procedure Requested Position
AFA-P01	AFAP01	Essential Turbine Driven AFW Pump	AF A	Pump	Standby	Any	OK for Work	N/A	Any	Protected	Any
AFB-P01	AFBP01	Essential Motor Driven AFW Pump	AF B	Pump	Standby	Any	OK for Work	N/A	Any	Protected	Any
AFN-P01	AFNP01	Non-Essential Motor Driven AFW Pump	AF N	Pump	Standby	Any	OK for Work	N/A	Any	Protected	Any
CHA-P01	CHAP01	Charging Pump A	CH A	Pump	Running	Any	Protected	Shutdown Safety Plan	Running	OK for Work	Any
CHB-P01	CHBP01	Charging Pump B	CH B	Pump	Standby	Any	OK for Work	N/A	Any	Protected	Any

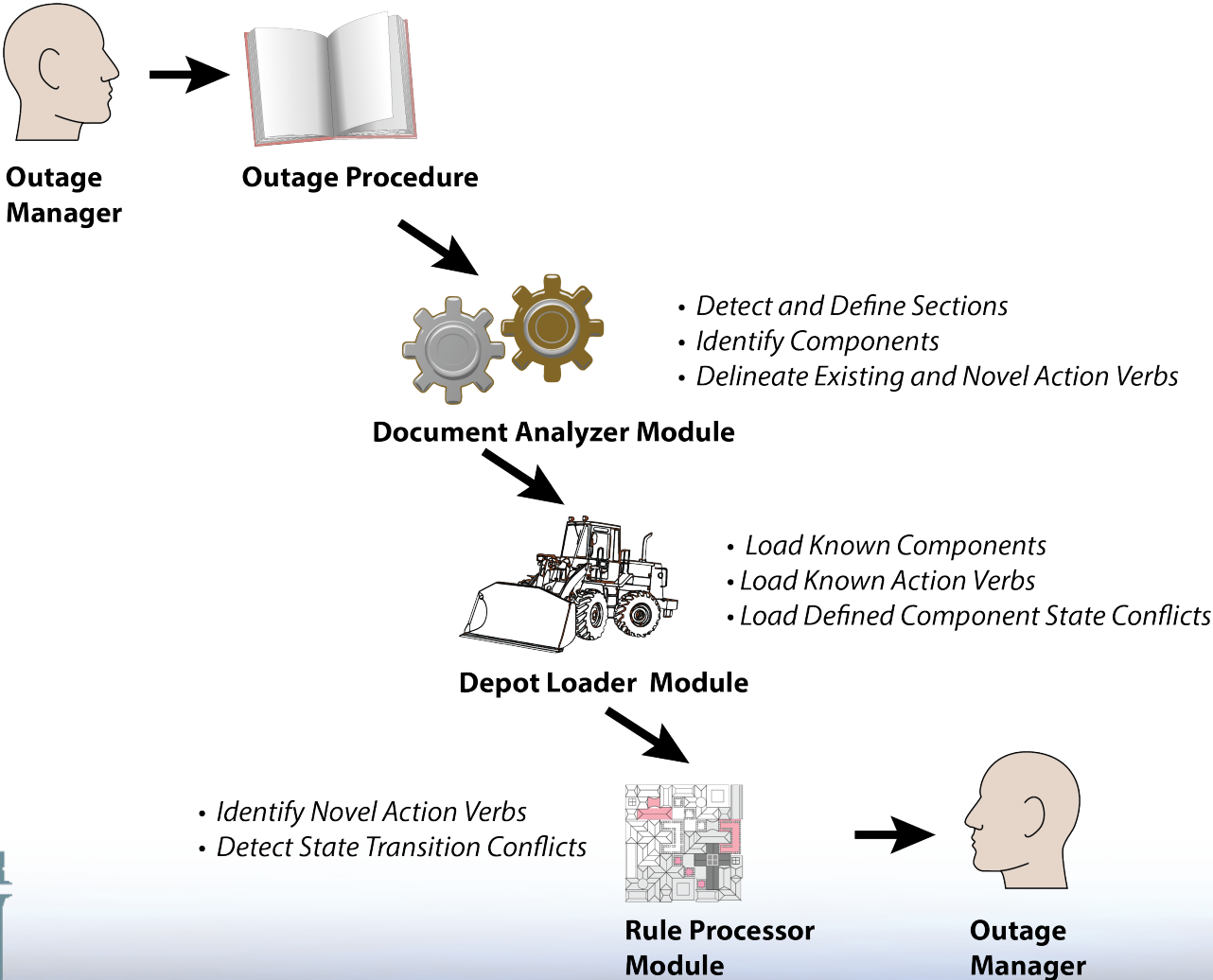


# Natural Language Processing

- Natural Language Processing will be used to evaluate upcoming procedures and work orders for manipulations of monitored components.
- System will look for combinations of identified Equipment IDs and action verbs to create a new component position.
- For example: Procedure step to close SIA-HV683 will result in LPSI pump A being unavailable.



# Extracting Component Information from Procedures



# Conclusions

- Working on a system to support the evaluation of work against various requirements.
- System will consolidate data from multiple sources related to important shutdown safety systems.
- System will evaluate upcoming plant operating states against current requirements and identify conflicts.

