

Advanced Instrumentation, Information, and Control Systems Technologies



Advanced Outage Control Center

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October 13, 2016

Light Water Reactor Sustainability R&D Program



Project Overview

- Develop Advanced OCC concepts to improve management of NPP outages.
- Use modern communication and collaboration technologies for outage coordination and problem resolution.
- Utility Partners –
 - Arizona Public Service (Palo Verde)
 - Southern Company
 - TVA
 - Duke Energy
 - Exelon
 - South Texas Project



AOCC Concepts



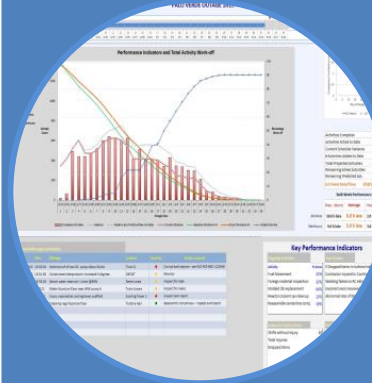
Real-Time collaboration for Emergent Issues



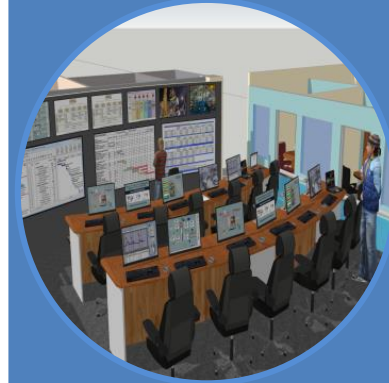
Improved communication of real-time outage status & discovered conditions



Automatic pending support notifications

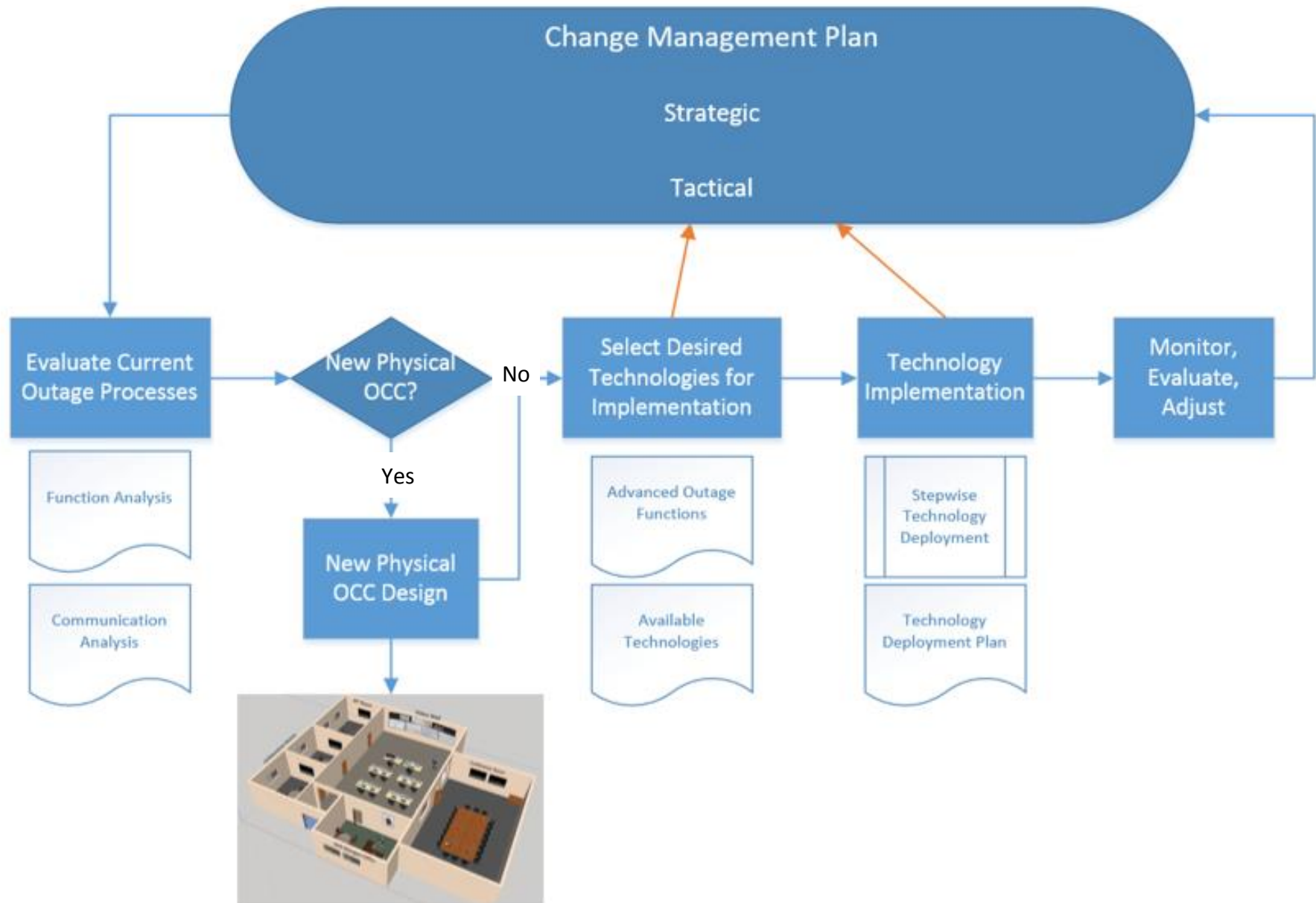


Advanced Outage dashboard for improved schedule management



Improved OCC physical design

AOCC Implementation Strategy



Accomplishments

- INL/EXT-16-37425: *“Design Concepts for an Outage Control Center Information Dashboard”* (M4)
- INL/EXT-16-39622: *“Development of an Overview Display to Allow Advanced Outage Control Center Management to Quickly Evaluate Outage Status”* (M3)
- Hugo, & St Germain (2016). *“Semiotic and Human Factors Principles in Information Dashboard Design”* IEEE Visual Languages and Computing. (In prep)
- Completed a dashboard prototype - Technology Readiness Level 6. Received a \$121K DOE grant to refine design and features required for commercialization.



Change Management



OCC layout redesign



Brunswick OCC Design Concept

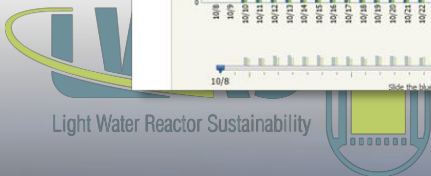
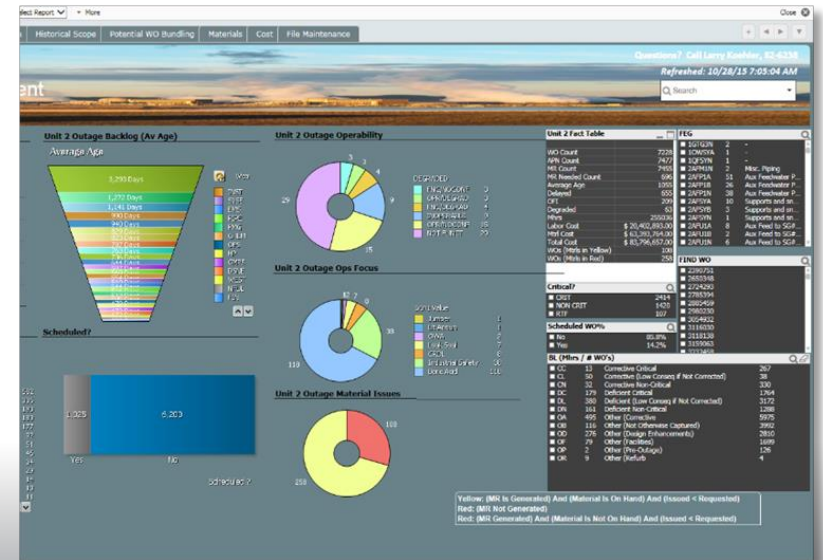
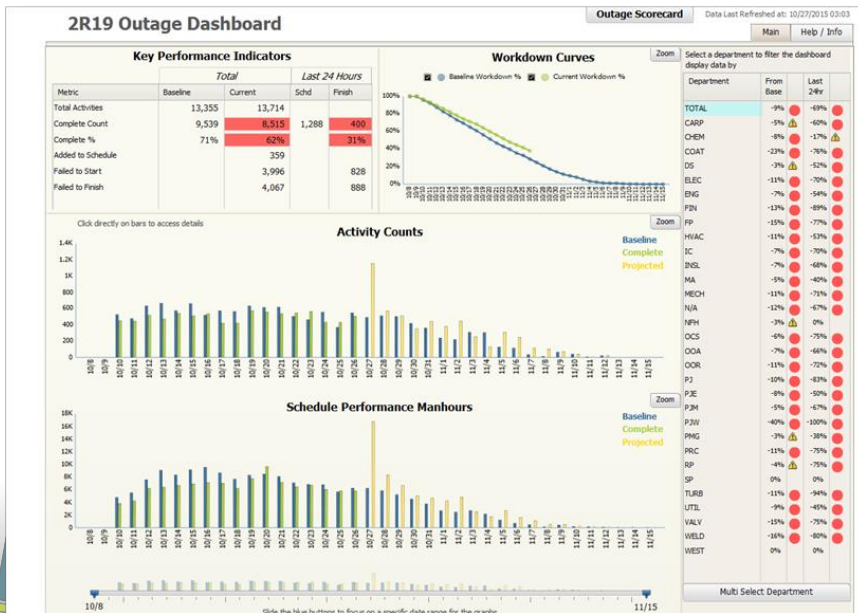
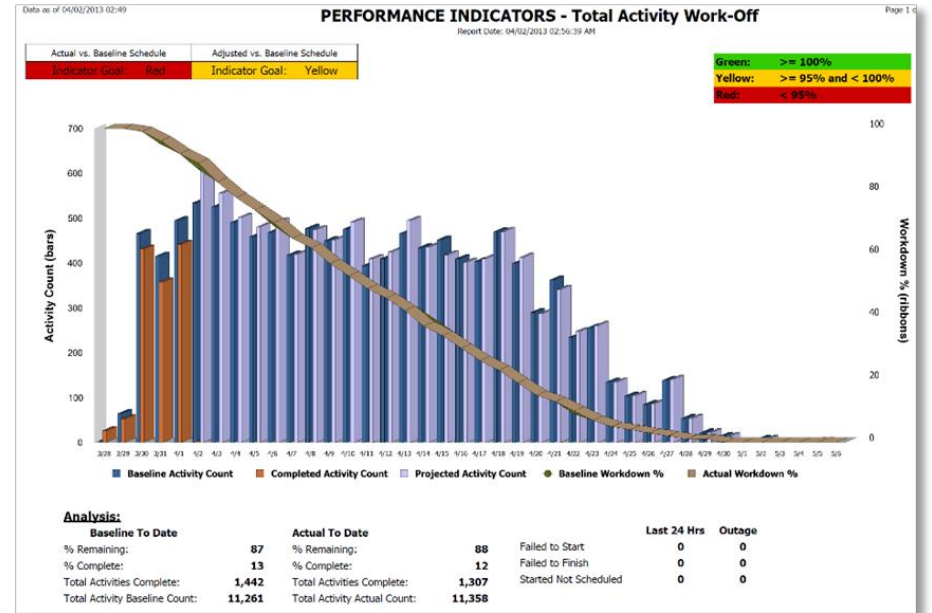


Concept to Reality



Old Dashboard Concepts

Unit	Crew	Activity ID	Description	Preds	Sched Start	Sched Comp	Actual Start	SA
A	MS40	AR04234088-00	DISTRIBUTE WATER AND OR ICE...	Yes	10-27-15 15:30	12-31-15 15:00	01-02-15 07:00	D
A	MM44	AF04563082-00	Need to rebuild 4 way valve S/N...	Yes	10-27-15 15:30	12-31-15 17:00	07-31-15 15:30	D
?	MM44	AF03558566-00	Rework spare CH-PSV105, apn# ...	Yes	10-27-15 15:30	12-31-15 13:00	05-20-15 12:00	D
?	RP	AF03558566-00	Rework spare CH-PSV105, apn# ...	Yes	10-27-15 15:30	12-31-15 13:00	05-20-15 12:00	D
3	MI23	3S04534712-00	365T9S103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	OOR3	3S04534712-00	365T9S103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	RP	3S04534712-00	365T9S103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	MC12	3S04663155-00	745T9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	RP	3S04663155-00	745T9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	OOR3	3S04663155-00	745T9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	EFF	3S04663155-00	745T9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	MTM1	3D04549320-00	Add roto hammer Reach Rod to ...	Yes	10-27-15 15:30	10-30-15 17:00		C
3	FP1	3S04422708-00	14FT9FP42-3 TASK C, PERFORM ...	Yes	10-27-15 15:30	11-01-15 16:30	10-26-15 05:00	C
3	RP	3S04422708-00	14FT9FP42-3 TASK C, PERFORM ...	Yes	10-27-15 15:30	11-01-15 16:30	10-26-15 05:00	C
3	MTM1	3D04549320-04	Mechanical activities.	No	10-27-15 15:30	11-03-15 17:00		C
3	EM31	3D04549320-05	Engineering activities.	No	10-27-15 15:30	11-03-15 17:00		C
3	MTM1	3D04549321-00	Add roto hammer Reach Rod to ...	Yes	10-27-15 15:30	11-03-15 17:00		C
3	MW21	3C04657766-00	Radwaste Caustic Batch Tank lin...	Yes	10-27-15 15:30	11-04-15 17:00	09-22-15 08:00	C
3	RP	3C04657766-00	Radwaste Caustic Batch Tank lin...	Yes	10-27-15 15:30	11-04-15 17:00	09-22-15 08:00	C
3	PJCS	3D04419812-03	(MB-1663) Form and pour PPT f...	No	10-27-15 15:30	11-09-15 17:00	10-19-15 07:00	C



New Dashboard Concepts

AOCC
Palo Verde 1R19
Admin

Date and Time: 10/5/2016 8:41

Critical Path

Start: 4/9/16 12:00 AM

Finish: 5/15/16 12:00 AM

Progress: 0 hrs

Day of: 36

Days Remaining: -2

Filter By Teams

Compare Teams

Activities

Man Hours

Performance Indicators and Total Activity Work-off

Team Comparison

Select All Apply

<input type="checkbox"/> CARP	<input checked="" type="checkbox"/> CHEM
<input type="checkbox"/> COAT	<input type="checkbox"/> DS
<input checked="" type="checkbox"/> ELEC	<input checked="" type="checkbox"/> ENG
<input type="checkbox"/> FIN	<input type="checkbox"/> FP
<input type="checkbox"/> GE	<input checked="" type="checkbox"/> HVAC
<input type="checkbox"/> IC	<input type="checkbox"/> INSL
<input type="checkbox"/> MA	<input checked="" type="checkbox"/> MECH
<input type="checkbox"/> NFH	<input type="checkbox"/> No Team
<input type="checkbox"/> OCS	<input type="checkbox"/> OOA
<input type="checkbox"/> OOR	<input type="checkbox"/> PJ
<input type="checkbox"/> PJE	<input type="checkbox"/> PJM
<input type="checkbox"/> PJW	<input type="checkbox"/> PMG
<input type="checkbox"/> PRC	<input type="checkbox"/> RE
<input type="checkbox"/> RP	<input type="checkbox"/> SP
<input checked="" type="checkbox"/> TURB	<input type="checkbox"/> UTIL
<input checked="" type="checkbox"/> VALV	<input type="checkbox"/> WELD
<input type="checkbox"/> WEST	

Current Outage

Completed	Scheduled To Date	Scheduled	Remaining
13545	13700	13738	193

Historical Outages

Completed	Scheduled To Date	Scheduled	Remaining
13518	13528	13528	10
12665	12666	12666	1
13726	13830	13877	151

Performance Indicators and Total Activity Work-off

Current Outage Details

Completed	Scheduled To Date	Scheduled	Remaining	Name
113	114	114	1	Palo Verde 1R18
0	0	0	0	Palo Verde 2R18
0	0	1	0	Palo Verde 2R19

Bulk Work Performance Details

Best Historical Outage		
Name	Activities Per Day	Man Hours Per Day
Palo Verde 1R18	366	4914.06

Worst Historical Outage		
Name	Activities Per Day	Man Hours Per Day
Palo Verde 3R18	326	4201.54

Average Historical Outage		
Name	Activities Per Day	Man Hours Per Day
Average	342	4520.65

Bulk Work Performance			
	Prev. Worst	Average	Prev. Best
Activities	07.97 h late	06.78 h early	07.10 h early
Man Hours	03.73 h early	19.35 h early	22.04 h early

Using Past Perfo

urrent

PV: 3R18

Conclusion

Feedback from industry:



- Outage managers need and want the dashboard tool. (Some utilities already use dashboards to show progress, but none [to our knowledge] is using historical data analysis to predict outage completion).

Application potential:



- Could be used by any commercial NPP - Stand-alone tool or incorporated into a larger work management software package.
- Licensed for inclusion by existing work management software companies, such as IBM, Curtiss-Wright, Pipeline, Rolls-Royce, and ABB.

Next Step - Outage Risk Management Improvement (ORMI) Pilot Project:



- Investigate methods to improve real-time plant risk management and configuration control during outage as a function of work activities and plant system alignments.
- Develop technologies to detect undesirable interactions between plant configuration and activities.

END

Questions?

