Advanced Instrumentation, Information, and Control Systems Technologies

Light Water Reactor Sustainability

Advanced Outage Control Center

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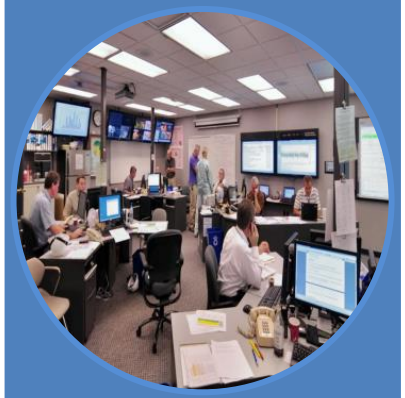
Light Water Reactor Sustainability R&D Program

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

LWRS Light Water Reactor Sustainability

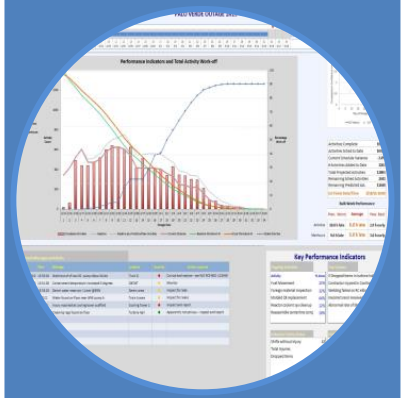
AOCC Concepts



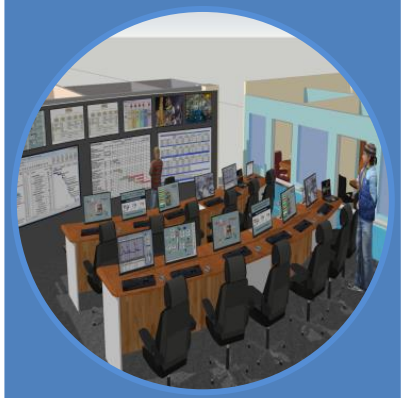
Real-Time collaboration for Emergent Issues

Improved communi-cation of real-time outage status & discovered conditions

Automatic pending support notifications

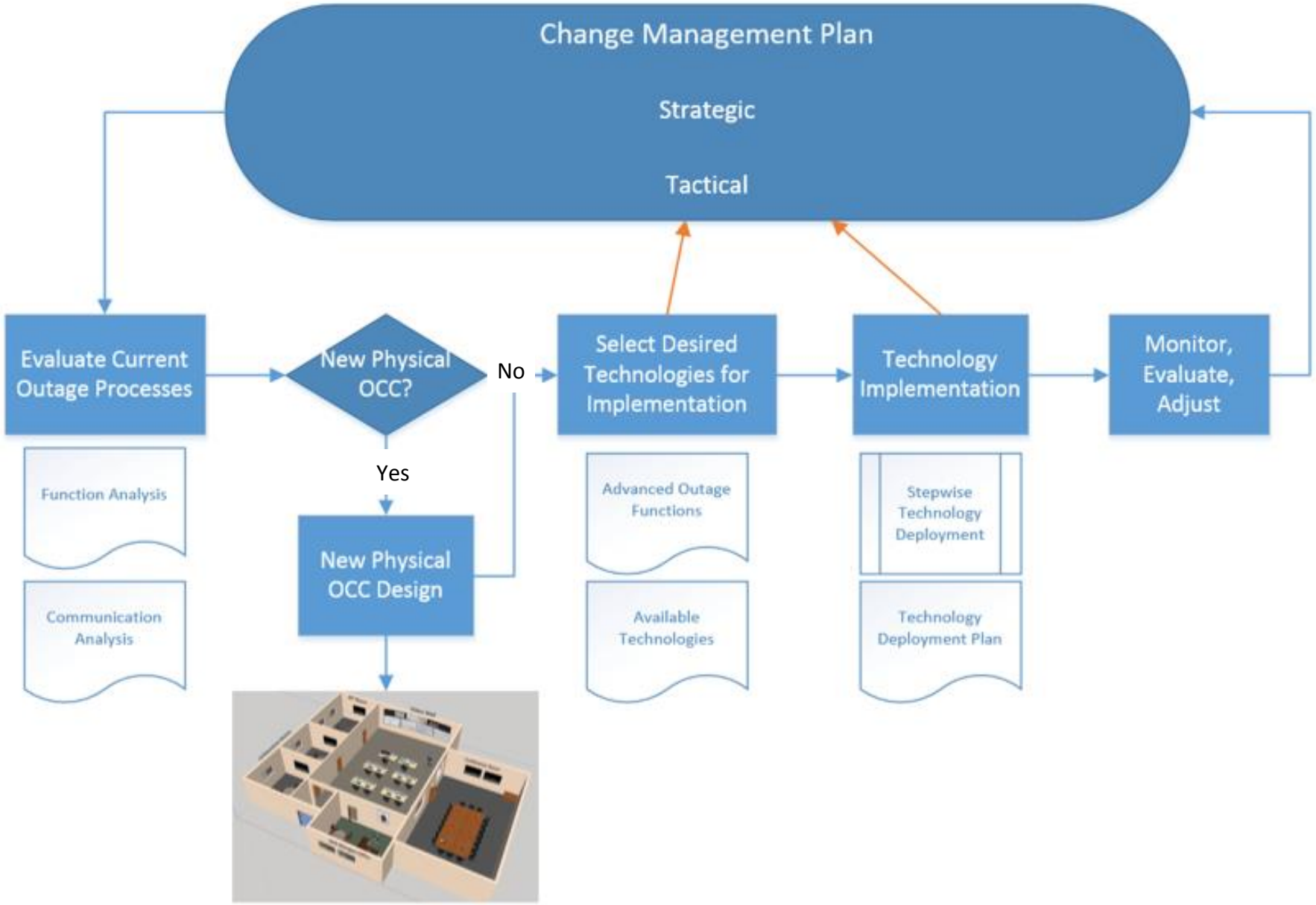


Advanced Outage dashboard for improved schedule management



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

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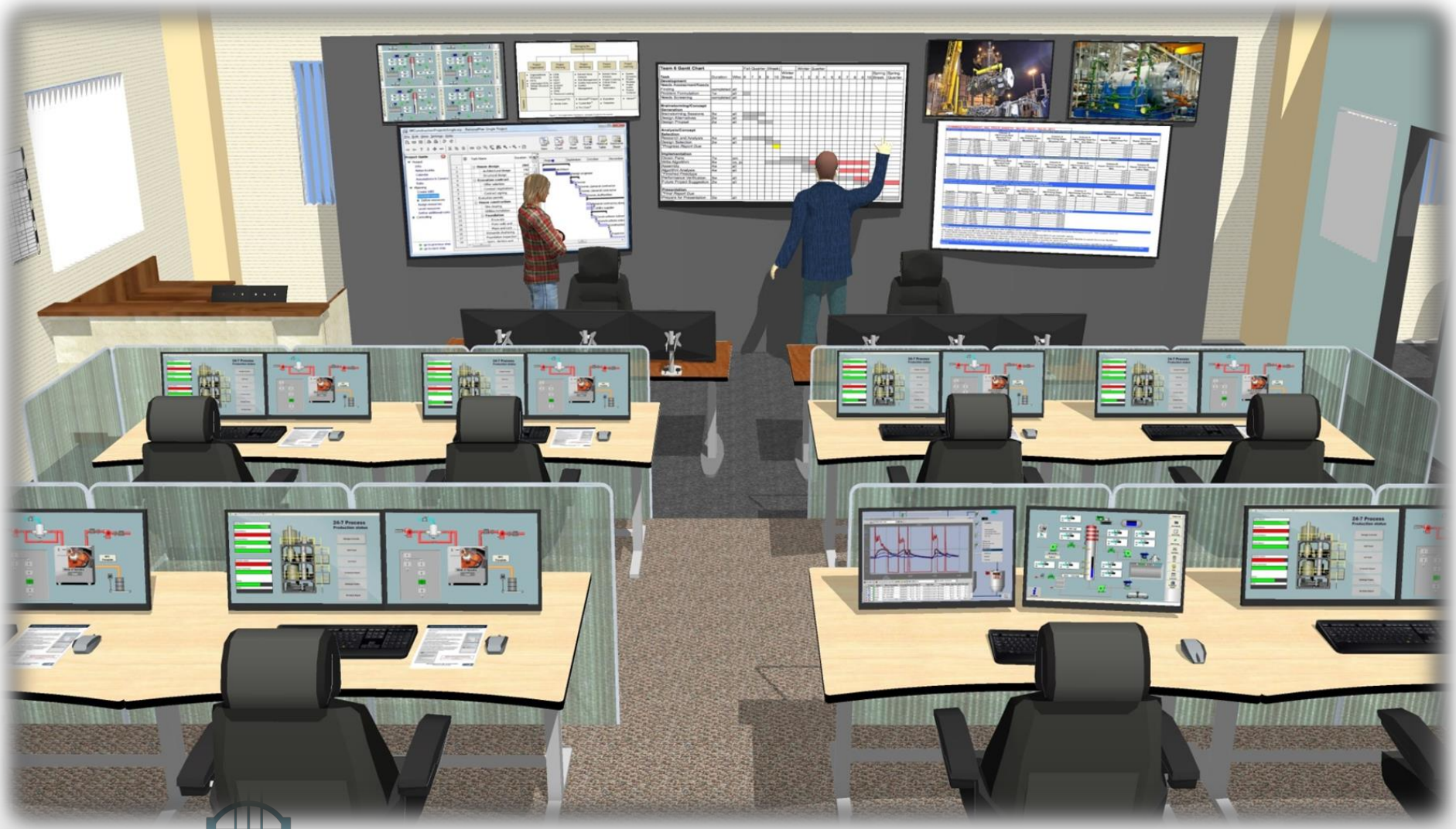
Brunswick OCC Design Concept



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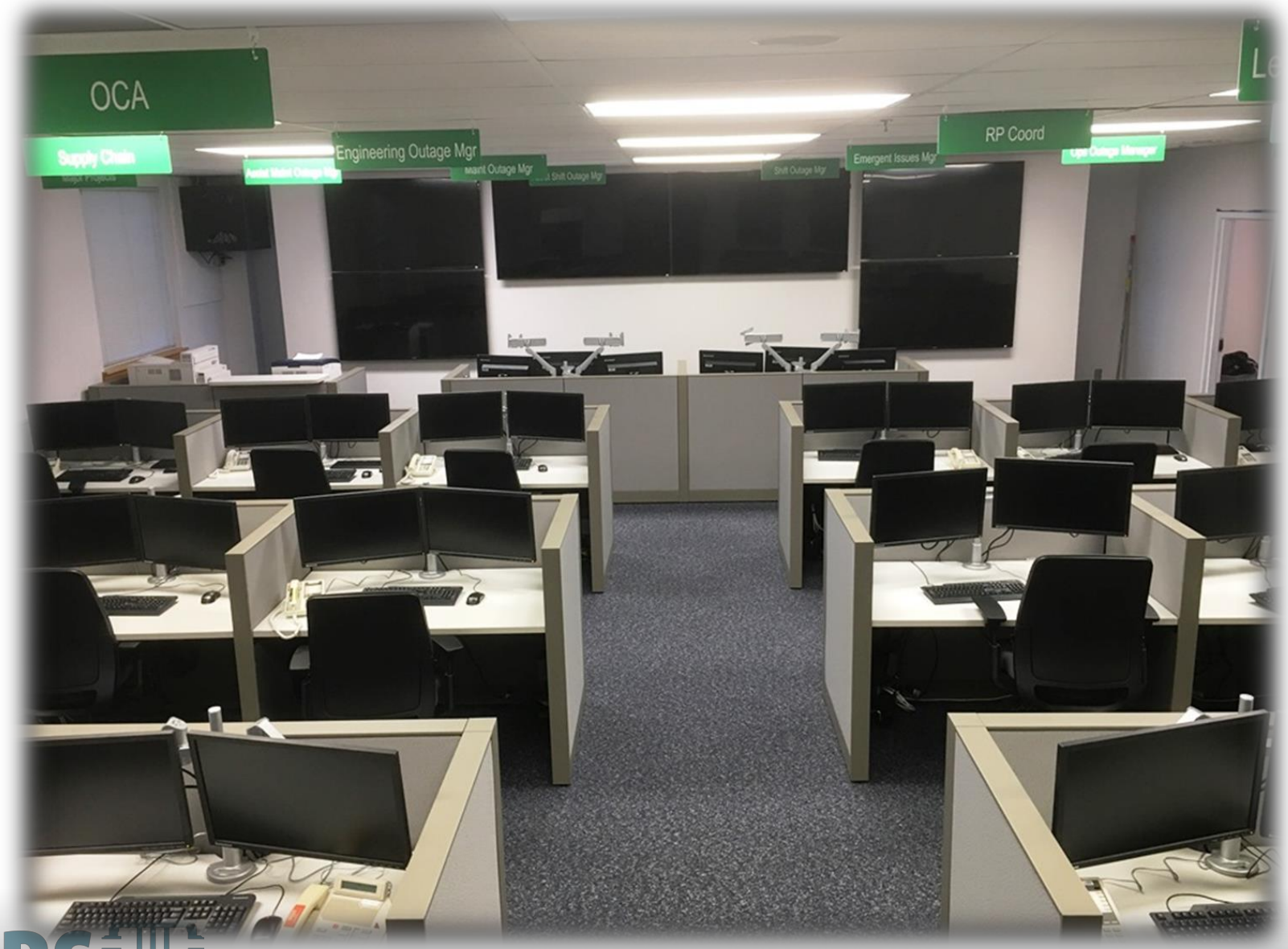
Concept to Reality



LWRS
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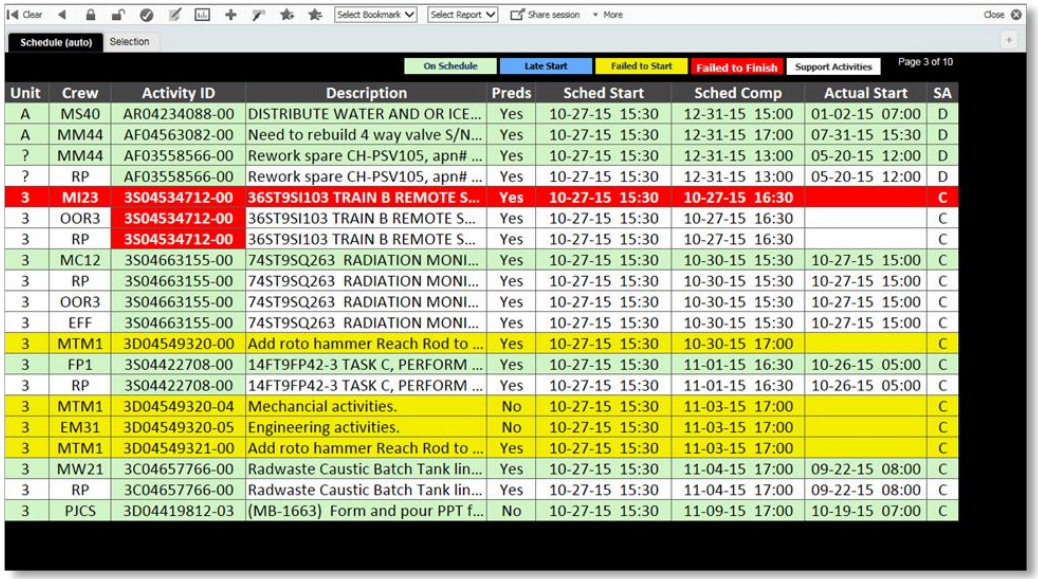
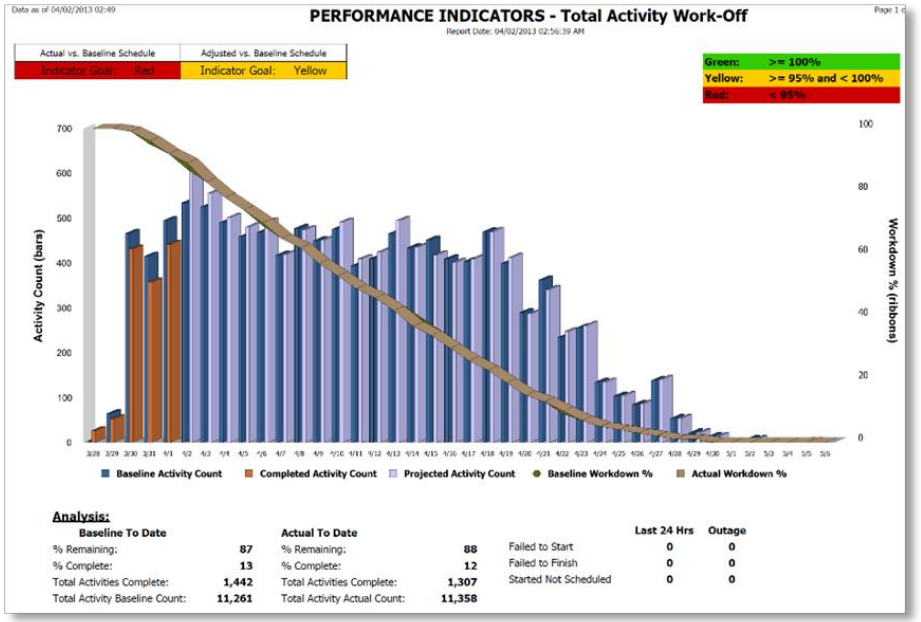
Old Dashboard Concepts

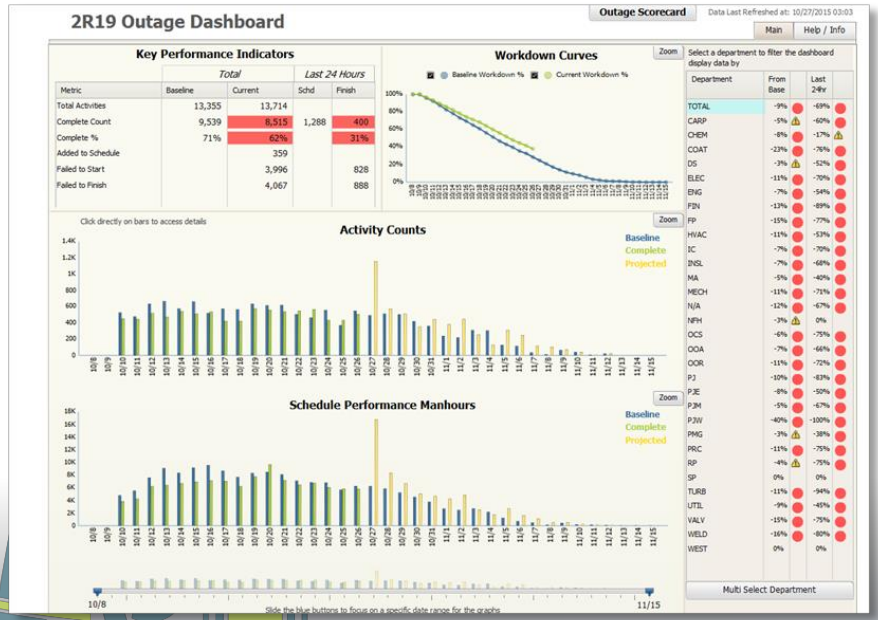


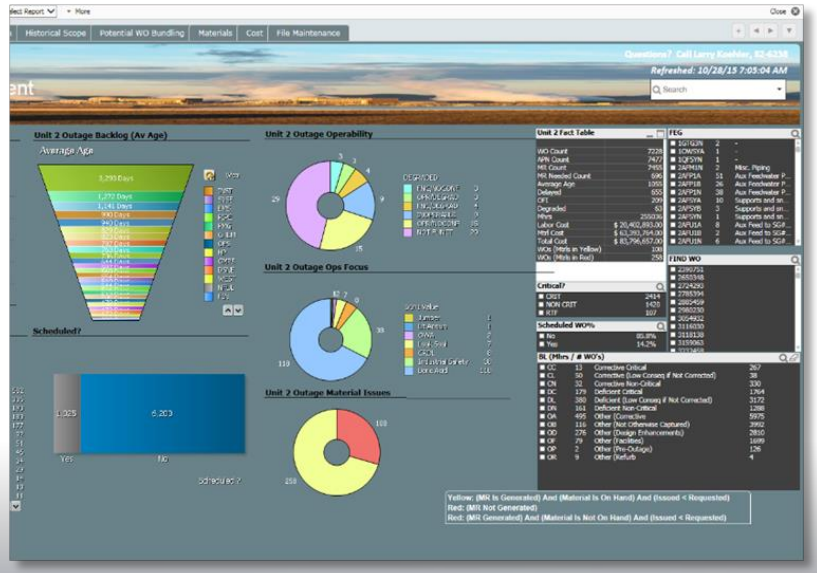
Schedule (auto) | Selection

On Schedule | Late Start | Failed to Start | Failed to Finish | Support Activities | Page 3 of 10

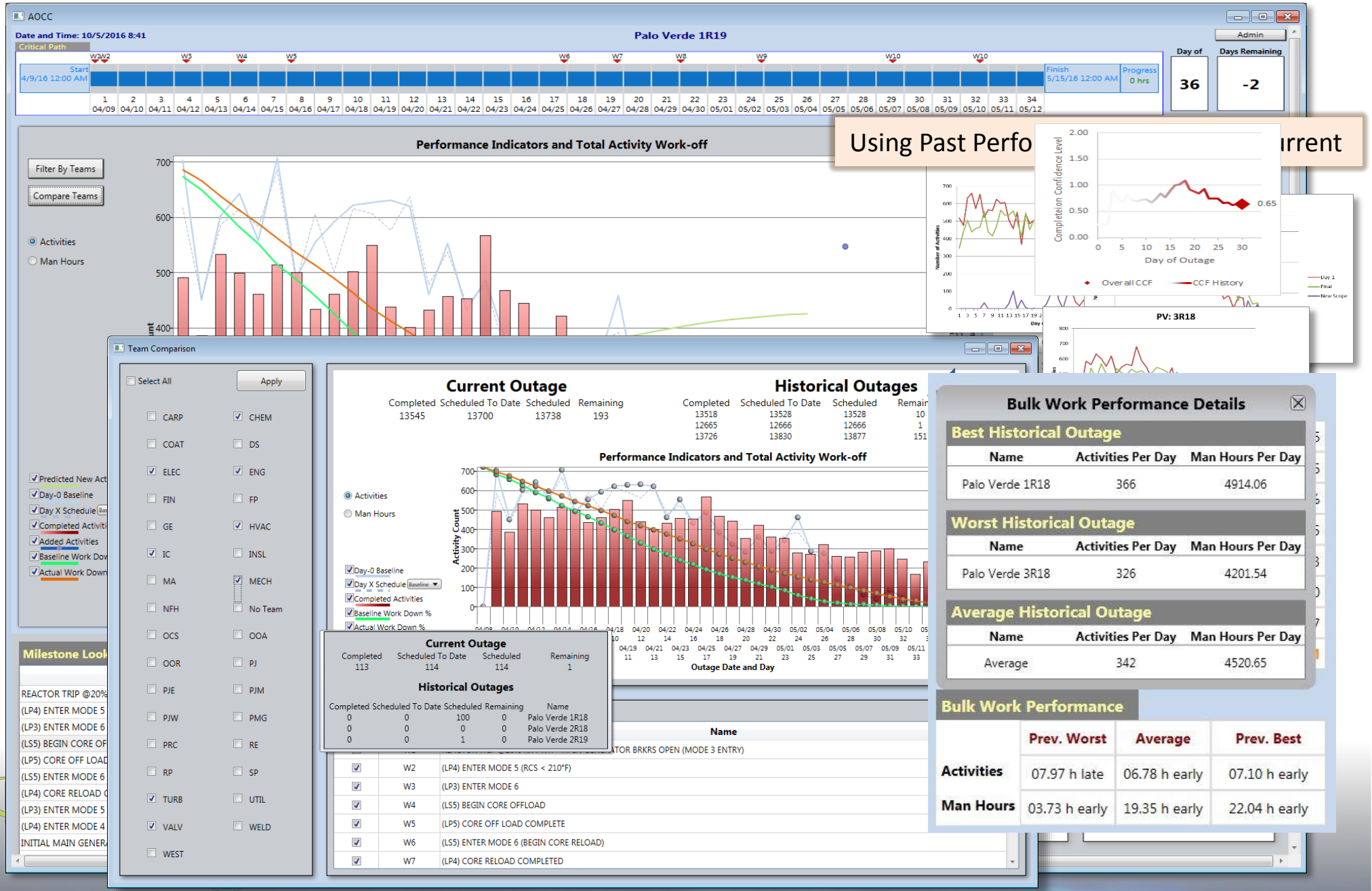
Unit	Crew	Activity ID	Description	Preds	Sched Start	Sched Comp	Actual Start	SA
A	MS40	AR04234088-00	DISTRIBUTE WATER AND OR ICE...	Yes	10-27-15 15:30	12-31-15 15:00	01-02-15 07:00	D
A	MM44	AF04563082-00	Need to rebuild 4 way valve S/N...	Yes	10-27-15 15:30	12-31-15 17:00	07-31-15 15:30	D
?	MM44	AF03558566-00	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	36ST9SI103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	OOR3	3S04534712-00	36ST9SI103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	RP	3S04534712-00	36ST9SI103 TRAIN B REMOTE S...	Yes	10-27-15 15:30	10-27-15 16:30		C
3	MC12	3S04663155-00	74ST9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	RP	3S04663155-00	74ST9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	OOR3	3S04663155-00	74ST9SQ263 RADIATION MONI...	Yes	10-27-15 15:30	10-30-15 15:30	10-27-15 15:00	C
3	EFF	3S04663155-00	74ST9SQ263 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	Mechancial 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



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?