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Light Water Reactor Sustainability Program

Advanced Instrumentation, Information, and Control Systems Technologies

Pilot Project Technology Business Case: Mobile Work Packages

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Pilot Project Technology Business Case: Mobile Work Packages

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List of Acronyms

BCM	Business Case Methodology
BCMW	Business Case Methodology Workbook
BEA	Battelle Energy Alliance
CBP	Computer-Based Procedures
FIN	Fix-It-Now
FTE	Full-Time Equivalent
II&C	Instrumentation, Information, and Control
KPI	Key Performance Indicator
LWR	Light Water Reactor
LWRS	Light Water Reactor Sustainability
M&TE	Materials and Test Equipment
MWP	Mobile Work Packages (including CBP)
NPP	Nuclear Power Plant
NPV	Net Present Value
O&M	Operating and Maintenance
R&D	Research and Development
RFI	Request for Information
WMS	Work Management System

Program Purpose

The Advanced Instrumentation, Information, and Control (II&C) Systems Technologies Pathway is part of the Department of Energy's Light Water Reactor Sustainability (LWRS) Program. It conducts targeted Research and Development (R&D) to address aging and reliability concerns with the legacy instrumentation and control and related information systems of the U.S. operating Light Water Reactor (LWR) fleet. This work involves two major goals: (1) to ensure that legacy analog II&C systems are not life-limiting issues for the LWR fleet and (2) to implement digital II&C technology in a manner that enables broad innovation and business improvement in the Nuclear Power Plant (NPP) operating model. Resolving long-term operational concerns with the II&C systems contributes to the long-term sustainability of the LWR fleet, which is vital to the nation's energy and environmental security.

The II&C Pathway is conducting a series of pilot projects that enable the development and deployment of new II&C technologies in existing nuclear plants. Through the LWRS program, individual utilities and plants are able to participate in these projects or otherwise leverage the results of projects conducted at demonstration plants.

The pilot projects conducted through this program serve as stepping stones to achieve longer-term outcomes of sustainable II&C technologies. They are designed to emphasize success in some crucial aspect of plant technology refurbishment and sustainable modernization. They provide the opportunity to develop and demonstrate methods to technology development and deployment that can be broadly standardized and leveraged by the commercial nuclear power fleet.

The II&C Pathway has developed a standard methodology for determining the impact of new technologies in order to assist NPP operators in building sound business cases. This business case study has been undertaken to quantify the benefits of Battelle Energy Alliance's (BEA) Mobile Work Package (MWP) and Computer-Based Procedure (CBP) technologies, to validate and refine the Business Case Methodology (BCM) with empirical data from a utility partner, and provide the key inputs to the utility partner for their internal business template.

Introduction to the Business Case Methodology

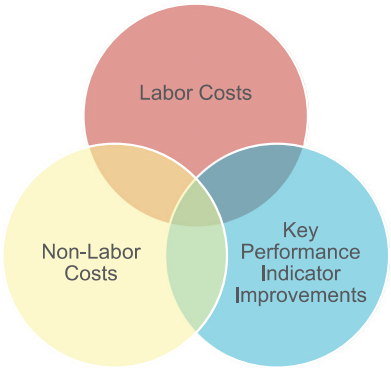
Performance advantages of the new pilot project technologies are widely acknowledged, but it has proven difficult for utilities to derive business cases for justifying investment in these new capabilities. Lack of a business case is often cited by utilities as a barrier to pursuing wide-scale application of digital technologies to nuclear plant work activities. The decision to move forward with funding usually hinges on demonstrating actual cost reductions that can be credited to budgets and thereby truly reduce operating and maintenance (O&M) or capital costs. Technology enhancements, while enhancing work methods and making work more efficient, often fail to

eliminate workload such that it changes overall staffing and material cost requirements. It is therefore necessary to demonstrate cost reductions as well as positive impacts on non-cost performance objectives in order for a business case to justify investment by utilities.

The BCM was developed in September of 2014[1] to frame the benefit side of II&C technologies—as opposed to the cost side—and how the organization evaluates discretionary projects (net present value (NPV), accounting effects of taxes, discount rates, etc.). The cost and analysis side is not particularly difficult for the organization and can usually be determined with a fair amount of precision. It is in determining the benefits side of the analysis that utilities have more difficulty in technology projects and that is the focus of this methodology. The methodology is presented in the context of the entire process, but the tool provided is limited to determining the organizational benefits only.

This BCM approaches building a business case for a particular technology or suite of technologies by detailing how they impact an operator in one or more of the three following areas: (1) Labor Costs, (2) Non-Labor Costs, and (3) Key Performance Indicators (KPIs) as illustrated in *Figure 1* below. Key to those impacts is identifying where the savings are "harvestable," meaning they result in an actual reduction in headcount and/or cost.

Figure 1. Key Areas of Impact



Impacts to NPPs in these three areas have been quantified to the best of our abilities based on interviews and observations, and built into a comprehensive business case for the adoption of a technology.

Business Case Methodology Purpose

The purpose of the BCM is to provide a structure for building the business case for adopting pilot project technologies in a manner that captures the total organizational benefits that can be derived from the improved work methods. This includes the direct benefit to the targeted work

[1] *Digital Technology Business Case Methodology Guide*, INL/EXT-14-33129, U.S. Department of Energy Office of Nuclear Energy, September 2014.

processes, efficiencies gained in related work processes, and avoided costs through the improvement of work quality and reduction of human error.

The BCM provides a structured guide for utility application, as well as identifies the NPP work processes to employ the business case methodology workbook (BCMW) for benefits/cost savings identification. This approach enables collaboration between the II&C Pathway and utility partner(s) in applying new technologies across multiple NPP organizations and their respective work activities, wherever there is opportunity to derive benefit. In this manner, the BCM drives an "economy of scale" that maximizes the value of the technologies relative to the implementation cost.

The BCM leverages the fact that, in spite of what seems to be a wide and disparate array of work activities among an NPP's operational and support organizations, the work activities themselves are largely composed of common tasks. For example, whether the work activities are in Maintenance, Operations, Chemistry, Radiation Protection, or even Security, they are largely composed of such common tasks as pre-job briefs, use of procedures, correct component identification, emergent conditions requiring work package alteration, etc. It is at this task level that the technologies are applied, and therefore the benefits of the technologies can be realized across as many plant activities as can be identified to employ these common tasks. As a result, a much more comprehensive business case can be derived with a commensurate increase in the benefit/cost ratio. This has the added benefit of driving consistency in work methods across the NPP organizations, a fundamental principle of successful NPP safety and operational management.

Project Purpose

The purpose of this business case study is to:

1) To provide the utility partner with the basis of an internal business case for implementing computer-based procedures based on the work efficiencies that can be identified and captured with a nuclear plant's organization.

2) To provide the nuclear industry with a sample business case for pilot project technologies that can be used as a template for pursuing similar implementations at other nuclear plants. This will be in the form of an experience report on the study using generalized data and will not include proprietary information of the participating plant operator.

3) To validate the BCM through practical application and to make refinements and improvements to it as warranted during the course of the study.

In this particular business case study, the pilot technology being evaluated is MWP, which includes CBPs and other automated elements of the work package. This technology enables time

savings through features such as smart place-keeping, smart branching, conflict detection and resolution, and seamless transition to other procedures. These features reduce the overhead, conflicts, and switching costs associated with executing procedures across a complex organization. A more thorough description of typical features for MWP is provided in Appendix A –Typical Features of Mobile Work Packages.

Improvements to BCMW

Several improvements were incorporated into the BCMW during the course of this study.

Labor Cost Savings

The prior BCMW calculated labor savings in terms of man-hours or Full-Time Equivalents (FTEs). A feature was developed and added to the BCMW to also estimate annual labor savings in dollar amounts. Typical industry hourly labor rates for various labor types were included as a separate tab in the BCMW as illustrated in *Figure 2* below.

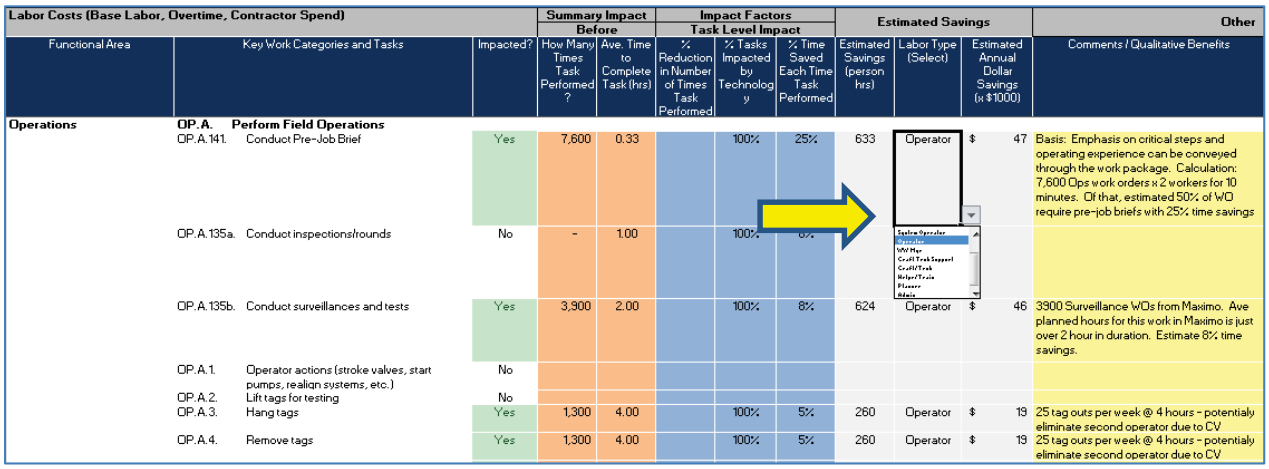
Figure 2. Typical Industry Labor Rates

Labor Rates (hourly)				
Labor Type	**Built-up Rate**	**Base Rate**	**Fringe**	**OT**
PM/Dir	126	85	28	13
Mgr/Engr	89	60	20	9
Supervisor	89	60	20	9
System Operator	59	40	13	6
Operator	74	50	17	8
WW Mgr	74	50	17	8
Craft Tech Support	74	50	17	8
Craft/Tech	59	40	13	6
Helpr/Train	52	35	12	5
Planner	67	45	15	7
Admin	33	22	7	3

Notes:
Rates presented are illustrative and believed to be typical for industry.
Rate assumes 33% fringe load and 10% OT & 1.5x base rate.
Fixed cost overheads not included in rate.

The “Labor Costs Tasks” sheet is fitted with additional columns with drop downs for the user to select the labor type best associated with the task and a second column to calculate the estimated the labor savings in dollar amounts as illustrated in *Figure 3* below.

Figure 3. Labor Type Selection Feature



Labor Costs (Base Labor, Overtime, Contractor Spend)			Summary Impact Before		Impact Factors Task Level Impact			Estimated Savings			Other
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed ?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits
Operations	OP.A. Perform Field Operations										
	OP.A.141. Conduct Pre-Job Brief	Yes	7,600	0.33		100%	25%	633	Operator	$ 47	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 7,600 Ops work orders x 2 workers for 10 minutes. Of that, estimated 50% of WO require pre-job briefs with 25% time savings
	OP.A.135a. Conduct inspections/rounds	No	-	1.00		100%	8%				
	OP.A.135b. Conduct surveillances and tests	Yes	3,900	2.00		100%	8%	624	Operator	$ 46	3900 Surveillance WOs from Maximo. Ave planned hours for this work in Maximo is just over 2 hour in duration. Estimate 8% time savings.
	OP.A.1. Operator actions (stroke valves, start pumps, realign systems, etc.)	No									
	OP.A.2. Lift tags for testing	No									
	OP.A.3. Hang tags	Yes	1,300	4.00		100%	5%	260	Operator	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV
	OP.A.4. Remove tags	Yes	1,300	4.00		100%	5%	260	Operator	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV

The “Labor Costs Categories” sheet is provided with an additional column to sum labor savings in dollar amounts from the “Labor Costs Tasks” sheet in addition to man-hours.

Likewise, total annual harvestable savings is now also calculated in dollar amounts, allowing for estimation of NPV.

NPV Estimating Tool

A simple tool is now available that pulls harvestable savings from the “Labor Costs Categories” sheet, along with minimal inputs provided by the user, to calculate the present value of the technology’s benefits. The resulting figure represents the maximum value of investment (in present terms) that can be made while still providing a net positive value to the operating plant. The tool is not intended to replace a thorough financial analysis of the project for investment, but rather to provide guidance that is reasonably accurate and directionally correct and inform whether or not to move to project into the next stage of development.

Labor Cost Savings Report

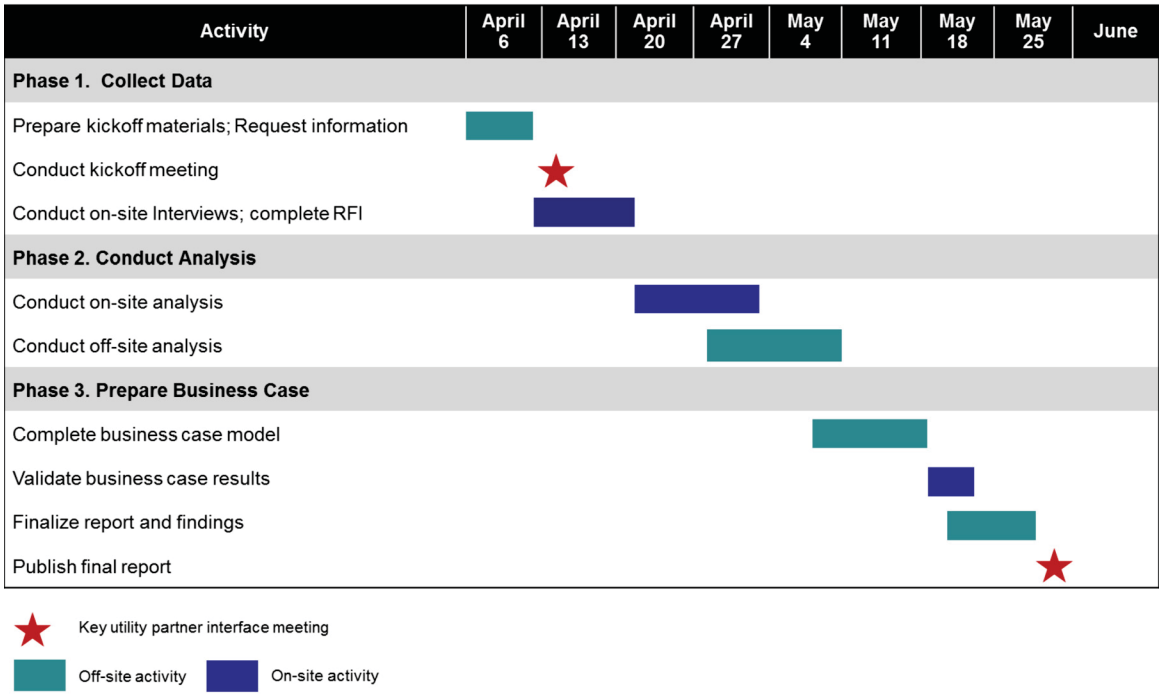
A feature was added to the BCMW to produce a summary report of labor cost savings from the “Labor Costs Tasks” sheet. This report is useful in that it consolidates the key information from “Labor Costs Tasks” sheet in a more concise format for ease of review.

Project Approach

Overview

The BCM validation study consisted of three phases outlined in *Figure 4*.

Figure 4. Project Plan



In the "Collect Data" phase, an operating NPP was selected from a set of plants willing to participate in the study and background information was provided as part of a kickoff meeting. Data was requested and collected to provide a basis for subsequent analysis and modelling.

The "Conduct Analysis" phase consisted of analyzing representative procedures and work plans to quantify the opportunities presented by the application of MWP. Data mined from the NPP's Work Management System (WMS) was used to quantify the volume of work performed by the plant. A field observation was also conducted to verify estimated savings by conducting time trials on a frequently run electrical surveillance procedure. Several new templates for conducting analysis were developed during this step.

In the "Prepare Business Case" phase, findings from the analysis were used to complete the BCMW and estimate to potential benefits of MWP in terms of labor and non-labor savings. Impacts to KPIs and other ancillary benefits were also evaluated. The BCMW was then reviewed with functional area representatives at the NPP to validate both the findings from the analysis and the business case results. Several enhancements to the BCMW were developed during this step as described in the prior section.

Phase 1: Collect Data

During the "Collect Data" phase, the project was kicked off at the host operating plant and data were collected and assessed through multiple channels.

Request for Information (RFI)

Prior to kicking off the project work at the operating plant, an RFI was submitted to the host organization to start the data collection process (refer to *Figure 5. Request for Information*).

Figure 5. Request for Information

Request for Information:

- Representative procedures and work packages
  - Operations
  - Maintenance (Mechanical, I&C, Electrical & FIN)
    - Preventive Maintenance
    - Corrective Maintenance
    - Design Change
    - Surveillance and Test
  - RP
    - Survey
    - Maintenance
  - Chemistry
    - Surveillance/Test
    - Sampling
    - Maintenance
- Procedure Use Data
- Detail Work Plans (two to three weeks)
- Completed WO report over full year
- Detailed org charts (including contractors)
- CAP report summarizing the last year identifying the number of CRs written related to Procedure Use and Adherence (PU&A)
- Any relevant prior studies conducted that is pertinent to the work

The purpose of the RFI is to gather a documented basis for determining the scope of work in each functional organization being examined, the types of work performed and the volume of work performed in terms of: (1) duration of activity (time) and, (2)number of times executed (quantity). The data that was collected was broken down by outage and non-outage months to identify the differences in workload for a given year at an NPP. In this regard, items such as organization charts, work plans, procedure use counts, and WMS data are all helpful in

determining the baseline of work at a level of granularity that can support a bottom-up approach[2] to the analysis. To support the bottom-up approach, procedures were requested from each functional area (Operations, Maintenance, RP and Chemistry) that are representative of the different types of work performed by the function in order to base the analysis at the lowest unit of work; the procedure step.

As is often the case conducting studies of this nature, the data requested is not always readily available, and alternatives or proxies must be considered. In this case, procedure use counts were not readily obtainable, and it was decided that data mined from the WMS is adequate as an alternative to support estimates of procedure use and work volume.

Kickoff Meeting

A kickoff meeting was scheduled to include key functional area representatives to review the project approach, describe the on-site activities, communicate project objectives, and define their role in the effort. Management representatives from the following areas participated:

- Maintenance Support
- Radiation Protection
- Chemistry Operations
- Shift Operations
- Work Management
- Procedures Group
- Information Technology

Interviews

Interviews were conducted with each functional area representative to gain an understanding of the scope how each organization functioned and gather key data and insights that would aide in estimating the benefits of helpful in estimating the benefits of MWP and CBP. Interviews were typically limited to one hour each. Key elements of the interviews included inquiry into organization structure, general work processes and work types, validation of the BCMW work breakdown structure, key processes for MWP focus, and interfaces with other work groups/support groups. In some cases (i.e., Chemistry), follow-up interviews were conducted to review procedures submitted as part of the RFI. Typical questions that might be asked during such interviews are provided in *Figure 6* below.

[2] A bottom-up approach is one by which the analysis is performed at a unit level that is representative or typical of work performed and then scaled to estimate the work of the broader organization.

Figure 6. Typical Interview Questions

Pre-job	Execution	Post-job

• How long does it take to brief this job?
• How many resources are required and when?
• How long does it take to plan this package?
• Any steps that make it particularly hard to plan?
• How long does it take to check qualifications?
• How long does it take to stage materials?
• Are there any steps that an electronic work package make easier?
	• How many times does a technician need to visit the control room?
	  • How long does it take?
	  • Does the whole crew travel including supervisor?
	• How many people did it take to execute the job?
	• Is the duration of the job on the schedule accurate?
	• How are independent verifications and controls managed?
		• What is the process you go through to close out a work package/procedure?
		• How long does it take?
		• Are all resources involved?
		• How are post job notes posted?
		  • Mark up procedures?
		  • Entered into a system?
		  • Scanned?
		• How long does it take to get the records to work package?
		• Planning/Admin: How long does it take to file/duplicate the records?

Field Observations

A field observation was conducted of a surveillance activity conducted by the Electrical Maintenance organization (*92 Day Battery and Charger Inspection and Maintenance*). An observer was assigned to shadow an electrical work crew during execution the selected procedure. The observer joined the crew at the start of the shift to view and documented pre-job activities such as the pre-job brief, completion of the task sheet, and preparation of Materials and Test Equipment (M&TE). Observations continued through job sign-on, execution of the procedure through to an unplanned work stoppage. A copy of the procedure was annotated during the observation to timestamp the start and completion of each step in the procedure, and to annotate potential efficiencies that MWP and CBP would introduce. The timeline was produced (as shown in *Figure 7* below) that was later analyzed to establish potential efficiencies introduced by the target technology at each procedural step.

Figure 7. Timeline of Observation

Field Observation - Procedure 28912-C

Battery Surveillance

Time Start	Time End	Procedure Step		Observed Duration (h:mm:ss)
7:30	8:15		Pull M&TE	0:45:00
8:15	9:02	1.0, 2.0, 3.1-3.5	Task Cover Sheet / Pre-Job Brief	0:47:00
9:02	9:06		Travel (2) to Ops	0:04:00
9:06	9:15	3.6-3.10	Sign out job (Ops)	0:09:00
9:15	9:24	4.1	Inspection and Maintenance	0:09:00
9:24	9:26	4.2	Battery terminal voltage measurement	0:02:00
9:26	9:31	4.3	leave battery room, go to charger room, verify tags - go to 4.3.3.	0:05:00
9:31	9:33	4.3.3.1-2	Verify readings - hold work	0:02:00
9:33	10:22		Approve work-around	0:49:00
10:25	10:28	4.5	Data sheet 1 Float Current	0:03:00
10:36	10:44	4.6	Data sheet 2 Cell float Voltage	0:08:00
10:44	10:48	4.7	Data sheet 2 Electrolyte Level	0:04:00
10:48	10:55	4.8	Data sheet 2 Specific Gravity (4 pilot cells)	0:07:00
10:55	11:02	4.10	Skip 4.9 - Visual cell and rack inspection	0:07:00
11:02	11:15		Close out work / cleanup / Return to shop	0:13:00
11:15	11:45	4.15	Post job (estimated) - signout, package sorting, approval, records, etc.	0:30:00
7:30	**11:45**			**4:15:00**

Incidentally, post-job activities were not documented during the observation due to a job interruption which caused work stoppage. However, the interruption did demonstrate the how simple disturbances in work flow can cause significant impacts to job performance.

Observations of this nature not only provide data that for determining efficiencies introduced by MWP and CBP, but also provide valuable insights to where technology offers the greatest benefits. Optimally, one would want to perform several observations on a variety of work types in this manner. Due to limitations in duration of this validation study, only one observation was performed.

Work Management Data

Data pulled from the plant's WMS provided a list of all work orders closed by the plant in 2014, including work type, on-line vs. outage work, crew assignment and planned work hours. In addition, a sample set of work orders were also surveyed on WMS to gather more detailed data related to specific procedures that were selected by maintenance as typical and representative of the work. Survey data was entered into a table as provided in *Figure 8* below.

Figure 8. Survey of Work Orders

WMS Sample Work Order Analysis

#	WO No.	Name	Work Type	Subwork type	Team	Craft	Qty	Plan Hrs	Tot Hrs	Associated Procedures	No. Dwgs	No. OE	Status	Status Date	Notes
1	SNC570304	(30 Day) Vertical Cast Transporter Inspection Monthly	PM		MECH1	Mech	1	4	4	93719-C NMP-MA-007-003	0	1	WKCOMP	10-Apr	32 hours charged actuals
2	SNC411979	2-1311-U4-911 Stuck	CM	CL (run to fail equip)	MECH1	Mech	2	12	24	20440-C	2	0	WKCOMP	21-Apr	
4	SNC421763	1157B7027M01 Motor Maintenance	PM		ELEC1	Elec	2	8	16	20429-C 25210-C 25732-C NMP-MA-012-GL02 NMP-MA-018 NMP-MA-018-F01	5	2	WKCOMP	10-Apr	
5	SNC541420	Heater Power Does not Meet Acceptance Criteria	CM	DN (non critical equip)	ELEC1	ELEC	2	8	16	20429-C 25072-C 29009-C	7	2	SCHED	8-Apr	while performing work...center heater element bad...not replaced easily...request ingineeirng to determin if duct can be rmoved or another manhose may be insoalled to access heater elements
6	SNC368193	Indicating lights not lit on Switchgear 2NA05-06	ELET	DN (non critical equip)	ELEC1	Elec	2	8	16	NMP-MA-018 NMP-MA-018-F01	7	1	WKCOMP	8-Apr	Bulbs replaced an still no light indicaiton. Problem should be ivestiged further by maint or other qualified individuals. Notified clearnance and tagging and control room. Verified that potential lights are lit at the QEAB
7	SNC441124	1202, 2FIT1820A, 18M-Cal, NSCW, CNMT Coolers, 5&6 supply, Header Flow	PM		IC1	IC	2	4	8	24234-2	3	1	COMP	8-Apr	
8	SNC441637	1405, 2FI-7280 Investigate Out of Spec TB rounds reading	CM	CL (run to fail equip)	IC1	IC	2	16	32	20429-C 22350-C NMP-MA-019 NMP-MA-009-F01	5	1	COMP	20-Apr	
9	SNC601098	1612, 1TE10005, Replace thermocouple input card, RPUA3	ELET	DN	IC1	IC	2	8	16	13521-1 22408A-C NMP-MA-009-F01 NMP-MA-018 NMP-MA-018-F01	3	1	SCHED	15-Mar	CR issued - replaced board but erroneous readings detected from 3 CETCs that feed the board - suspect rolled wires somewhere down the line - need to coordinate with SME, system eng,
10	SNC424685	2A Tower - Pull VIB Cable	DCPI		ELECCNTR		1	1	1	00352-C 25714-C 25731-C NMP-MA-007 NMP-MA-009	3	2	COMP	15-Mar	Actual hours indicated as 41.5 hrs and involving 4 craft eletrictians (Contract)

Legend:
DC - Design Change
Elec - Deficient/Other
PM - Preventive
CM - Corrective

Organization Charts

Organization charts were used to examine how each function is staffed and also allowed comparison of staffing to benchmark values input in the BCMW. They were also used as a basis for interviews to gain understanding of the scope of each functional area as well as how work is distributed and how shifts are planned.

Work Week Plans including Histograms

Work week plans and schedules were collected for the weeks the study was conducted. These plans provided a snapshot of the work conducted and illustrated the interfaces between functions in conduct of work. Histograms, together with the org charts above, provided insight to how work plans are resource loaded.

Corrective Action Program

A listing of Condition Reports over the past year from the Corrective Action Program was reviewed to identify the types of Procedure Use and Adherence (PU&A) issues the plant is experiencing, as well as to validate the beneficial impact of the MWP and CBP technologies in reducing these types of human errors.

Phase 2. Conduct Analysis

During the "Conduct Analysis" phase, data were assessed through multiple channels. Relevant procedures were analyzed to quantify opportunities for efficiency gains presented by MWP. This was then combined with data collected from interviews, field observations, and the number and duration of work orders to estimate the opportunity for process improvement.

The study confirmed the intuitive sense that the majority of the efficiency gains with MWP are associated with the set-ups and close-outs of the various procedures. Also, the majority of the error reduction benefits are associated with the MWP and CBP features that support field work execution. This will be discussed at greater length in the results section.

Analysis of Procedures

The operating plant provided a sample of representative procedures for each of the areas for analysis as requested in the RFI (refer to Appendix B for list of these procedures). The procedures provided were determined by plant functional area representatives to be typical of the scope and complexity for the work they described. A subset of these procedures was selected and analyzed to determine the number of opportunities to improve efficiency of execution of the procedures introduced by the technology being evaluated.

For each procedure that was analyzed in detail, a Microsoft Word file version was reviewed step-by step, using track change comments to annotate the specific opportunities to use the MWP features.

A template was created to summarize the annotations made to the procedures and quantify the number of opportunities per procedure in tabular form. This process was helpful in understanding the frequency by which different features of CBP may be introduced into the reference procedure. A sample of this template is provided in *Figure 9* below.

Figure 9. Procedure Analysis Template

Opportunities	Procedure
Procedure No.	28912-C
Procedure Rev.	67
Title/Description	92-day Battery and Charger Inspection and Maintenance
Functional Area	Maint
Subfunction	Electrical
Work Type	Surveillance
Ref. WO (if available)	n/a
Planned Hours (if available)	n/a
Job Planning and Preparation	
Planning	1
Package Assembly	1
Support Group Walkdown	1
Execute Support Activities	
Lock-out Tag-out	
RP Planning	
Dose Estimates	
Risk Asssessment (ORA)	
Craft support	
Execution Group Walkdown	1
Pre-Job Activities	
Pre-Job Brief	1
Collect materials	1
Assemble tools	1
Fill out Task Sheet	1
Sign on job	1
Procedure Execution	
Authorizations	4
Smart Placekeeping (within procedure)	60
Smart Branching (to other procedures)	16
Smart Workflow (i.e. CAR, WR)	10
Scan for Data Entry/Verification	17
Auto-calculate	5
Set Shot Clock	4
Data Verification/Acceptance	8
Obtain Reference Data (Equip)	2
Obtain Plant Operating Data	1
Obtain Reference Documents/Forms	4
Provide Status Updates to Control Center	1
JIT Operating Experience	3
Data Sheets	2
Check M&TE	1
Real-Time Collaboration (i.e., Ops)	5
Concurrent Verification	2
QC Hold Point Coordination	
Independent verification Coordination	2
Ops Activity	1
Post-Job Activities	
Supervisor Approval	1
QA Approval	1
Prepare package for archiving	1
Tear down package / Archive records	1

In the case where the procedure was observed in the field, the same version of the procedure was also annotated with notes and time stamps to record insights into how the technology would work and how long it took to perform various portions of the procedures. Efficiencies were then estimated against each step observed as shown in *Figure 10* below.

Figure 10. Analysis of Field Observation

Battery Surveillance

Time Start	Time End	Procedure Step	Description of Activity	Observed Duration (h:mm:ss)	Estimated Time Savings (h:mm:ss)	Estimated Efficiency (%)	Comments
7:30	8:15		Pull M&TE	0:45:00	0:05:00	89%	
8:15	9:02	1.0, 2.0, 3.1-3.5	Task Cover Sheet / Pre-Job Brief	0:47:00	0:10:00	79%	
9:02	9:06		Travel (2) to Ops	0:04:00		100%	
9:06	9:15	3.6-3.10	Sign out job (Ops)	0:09:00	0:04:00	56%	
9:15	9:24	4.1	Inspection and Maintenance	0:09:00		100%	
9:24	9:26	4.2	Battery terminal voltage measurement	0:02:00		100%	
9:26	9:31	4.3	leave battery room, go to charger room, verify tags - go to 4.3.3.	0:05:00	0:01:00	80%	
9:31	9:33	4.3.3.1-2	Verify readings - hold work	0:02:00		100%	
9:33	10:22		Approve work-around	0:49:00	0:02:27	95%	Uncommon issue, but take 5% savings for avoided interuptions
10:25	10:28	4.5	Data sheet 1 Float Current	0:03:00	0:00:30	83%	
10:36	10:44	4.6	Data sheet 2 Cell float Voltage	0:08:00	0:00:30	94%	
10:44	10:48	4.7	Data sheet 2 Electrolyte Level	0:04:00	0:00:30	88%	
10:48	10:55	4.8	Data sheet 2 Specific Gravity (4 pilot cells)	0:07:00	0:00:30	93%	
10:55	11:02	4.10	Skip 4.9 - Visual cell and rack inspection	0:07:00		100%	
11:02	11:15		Close out work / cleanup / Return to shop	0:13:00		100%	
11:15	11:45	4.15	Post job (estimated) - signout, package sorting, approval, records, etc.	0:30:00	0:10:00	67%	May include work done by Admins
7:30	**11:45**			**4:15:00**	**0:34:27**	**86%**	
						14% gain in efficiency	

Analysis of Work Orders

A list of all work orders closed for an entire calendar year was provided by the operating plant. The listing could be separated between outage and online work and also indicated the work type code, function area assignment, work team assignment, and the planned hours. The work orders were then segregated into functional areas and presented in a table to indicate the number of work orders completed and planned hours. For the Maintenance organization, the data was further broken down into the craft disciplines of Mechanical, Electrical, Instrument and Control, and Fix-It-Now (FIN) organizations.

Because the work order data was provided for a year containing two outages, the outage and online figures were normalized for 1.33 outages per year to represent an average year. The resulting data is presented in Appendix C.

Analysis of Work Packages

Based on the analyses conducted for procedures and work orders above, an estimate was made of overall efficiencies introduced by MWP for two major classes of work packages: 1) Maintenance – which included various work types (e.g., corrective maintenance, preventive maintenance, deficiencies, and design changes); and 2) Operations, RP and Chemistry – which primarily consisted of surveillances and equipment operations. For illustrative purposes, examples of these estimates are provided in *Figure 11* and *Figure 12* below.

Figure 11. Estimated Work Package Efficiency – Maintenance

Estimate of Maintenance Efficiencies					No of Work Orders:	13,300	Total Planned Hrs:	180,000
#	Execution Subtask	Typical Number of Instances per WO	Minutes Saved per Instance	% of WO's with Opp'y	Estimated Opp'y per WO (minutes)	Estimated Man-Hour Savings	Notes	
1	Authorizations				0	0	Covered elsewhere in BCM Model	
2	Smart Placekeeping (within procedure)				0	0	Benefit is elimination of PU&A errors	
3	Smart Branching (within procedures)	3	2	80%	4.8	1064		
4	Smart Branching (to other procedures)	2	1	100%	2	443		
5	Smart Workflow (i.e. CAR, WR)	1	15	5%	0.75	166		
6	Complete Task Cover Sheet	2	10	100%	20	4433		
7	Auto-calculate	2	10	25%	5	1108		
8	Set Shot Clock/Required Actions	1	15	1%	0.15	33		
9	Data Verification/Acceptance	5	2	40%	4	887	PMs and Surveillances only	
10	Obtain Reference Data (Equip)	5	2	80%	8	1773		
11	Obtain Plant Operating Data	2	15	10%	3	665		
12	Obtain Reference Documents/Forms (not in package)	1	30	5%	1.5	333	Mostly DC's and CO/Def	
13	Detect Work Conflicts				0	0	Benefit to Ops in Risk Mgmt	
14	Provide Status Updates to Control Center	3	5	80%	12	2660		
15	JIT Operating Experience	1	1	50%	0.5	111		
16	Data Sheets	2	15	25%	7.5	1663		
17	Check M&TE				0	0	Covered elsewhere in BCM Model	
18	Real-Time Collaboration (i.e., Ops)	1	20	5%	1	222		
19	Concurrent Verification				0	0	Covered elsewhere in BCM Model	
20	QC Hold Point Coordination	1	15	25%	3.75	831	Enabled by microscheduling	
21	Independent verification Coordination	5	15	20%	15	3325		
22	Ops Activity (e.g., temp lift of tags)	1	15	25%	3.75	831		
					Total Man-Hour Savings:	20,549		
					% Reduction in Man-Hours:	11.4%		

Figure 12. Estimated Work Package Efficiency – Operations, Radiation Protection, and Chemistry

Estimate of Ops RP & Chemistry Efficiencies					No of Work Orders:	20,000	Total Est Hrs	104,000
#	Execution Subtask	Typical Number of Instances per WO	Minutes Saved per Instance	% of WO's with Opp'y	Estimated Opp'y per WO (minutes)	Estimated Man-Hour Savings	Notes	
1	Authorizations	1	15	10%	1.5	500		
2	Smart Placekeeping (within procedure)				0	0		
3	Smart Branching (within procedures)	3	2	20%	1.2	400		
4	Smart Branching (to other procedures)	1	1	20%	0.2	67		
5	Smart Workflow (i.e. CAR, WR)	1	10	5%	0.5	167		
6	Complete Task Cover Sheet	1	5	25%	1.25	417		
7	Auto-calculate	5	5	15%	3.75	1250		
8	Set Shot Clock/Required Actions	1	10	1%	0.1	33		
9	Data Verification/Acceptance	5	2	40%	4	1333		
10	Obtain Reference Data (Equip)	5	2	40%	4	1333		
11	Obtain Plant Operating Data	2	10	10%	2	667		
12	Obtain Reference Documents/Forms (not in package)	1	10	5%	0.5	167		
13	Detect Work Conflicts				0	0		
14	Provide Status Updates to Control Center	2	5	15%	1.5	500		
15	JIT Operating Experience	0	1	50%	0	0		
16	Data Sheets	5	5	15%	3.75	1250		
17	Check M&TE				0	0		
18	Real-Time Collaboration (i.e., Ops)	1	20	5%	1	333		
19	Concurrent Verification				0	0		
20	QC Hold Point Coordination	0	15	25%	0	0		
21	Independent Verification Coordination	0	15	20%	0	0		
22	Ops Activity (e.g., temp lift of tags)	0	15	25%	0	0		
					Total Man-Hour Savings:	8,417		
					% Reduction in Man-Hours:	8.1%		

The average number of procedures for each work order was determined to be two to three, according to key station managers. Two was used in the study as a conservative figure in the study. However, this figure proved not to be critical to the analysis in that the study looked at the job from the standpoint of the work packages and the types of actions that would have to be taken to accomplish the work activity, regardless of how many procedures that represented. It was also recognized that some of the features would be resident in the CBP (or any form of computer-based work instructions) while others were resident in the MWP.

The result of the analysis produced an estimate of 11% efficiency gain in Maintenance work and 8% gain in Operations, RP and Chemistry surveillances. The results of the analysis are useful when estimating labor benefits and are applied directly in the BCMW.

Phase 3. Prepare Business Case

Labor Savings

The procedure and work package analysis developed as part of Phase 2, was used to determine average efficiency factors for the major types of work activities. These efficiency factors were multiplied against the total instances that each type to produce the aggregate benefit in terms of reduced work hour requirements. These reduced work hours were converted to cost savings by use of industry standard labor rates.

The scope of the study did not allow for rigorous counts of all data parameters of interest. Therefore, expert judgment was used to estimate those parameters that could not be readily measured from the data sources available. An example is the percent of all maintenance jobs that require continuous Radiation Protection coverage.

In these cases, the parameter estimates were provided by the knowledgeable plant staff or a project team member with nuclear plant operational experience. In all cases, the parameters were peer checked with the plant staff for reasonability.

Labor savings were also identified in related work processes where the technology features enabled such efficiencies. As an example, smart data sheets in procedures can be designed to automatically transfer collected data directly to programmatic data bases once the procedure is approved, eliminating the need to manually transfer this data as well as eliminating transcription errors when doing so.

It would be prudent for a utility using the BCM for an actual business case to verify all parameters with actual counts or other types of data analysis.

Harvestability is the fraction of cost savings that can be taken as a budget reduction. This can be in the form of labor spend or reduced non-labor expenditures. Because most of the benefits of this study result in a reduction in labor, the savings can be expressed in terms of reduction in FTEs, or a reduced requirement for staff. However, when the labor reductions apply to just a portion of the job responsibilities for certain types of staff, then it might not be possible to eliminate the equivalent number of positions. Or the staffing level might be driven by something other than normal work load, such as the minimum staff needed for emergency response. In these cases, the reduced labor benefits create an opportunity for the affected staff members to take on additional responsibilities.

In this study, each of the major labor categories is examined and only a portion of the savings are designated as harvestable. This is based on the judgement of the project team, but can be easily adjusted in the BCMW by a utility customizing the business case for their specific circumstances.

Non-Labor Savings

Non-labor saving were largely estimated as the elimination printed work packages and drawings and the resulting reduction of consumable office products that include but are not limited to paper, printer and plotter consumable supplies, printer and plotter maintenance. The number of work packages produced was estimated using the analysis conducted of work order quantities and the quantity of paper consumed per package were estimated using data from the Work Order Survey conducted on WMS. An "all-in" rate of 10 cents per sheet of paper was used as the cost of consumables to produce the work package.

Sensitivity Analysis

In all cases in this analysis where metrics were not available as a direct result of observation or data analysis, a conservative estimate was used using expert judgment. As such, the figures reported above represent the lower bound of the BCM benefits of the II&C technology. While changes to the inputs would have a linear impact on outputs, the results reported here are meant to show the lower bound and upside of the BCM as applied to a practical case. For this reason a sensitivity analysis was not conducted.

Validation of Estimates

The completed BCMW was reviewed with functional area representatives at the operating plant for validation. Management representatives from the following areas participated in validation of their respective areas:

- Work Management (reviewed Work Management and Maintenance sections)
- Radiation Protection
- Chemistry
- Operations (Operations Support Manager and four System Operators)

Results

Key Findings

The outcome of the application of the methodology is a promising financial analysis of the costs and benefits associated with the adoption of a new technology on a nuclear site. The results could be made more robust by additional observational timings or access to data. The BCM indicates there are approximately $3.5 million in annual savings made up of $3.3 million of harvestable labor savings, $0.2 million of non-labor savings, and allowing for an investment of over $20 million in present terms.

In all cases in this analysis where metrics were not available as a direct result of observation or data analysis, a conservative estimate was used. As such, the figures reported above represent the

lower bound of the BCM benefits of the II&C technology. While changes to the inputs would have a linear impact on outputs, the results reported here are meant to show the lower bound and upside of the BCM as applied to a practical case.

The following have been identified as the key drivers of the labor savings:

- Implementation of MWP features that enable correct component verification and other features that eliminate the need for concurrent verification will allow a single technician to perform tasks without a second helper or technician present. It was estimated that approximately 20% of maintenance work performed could realize an efficiency gain of 33%. Additionally, this supports a current industry movement to reduce the effects of cumulative impacts.
- Analysis of procedures, work packages and field observations suggest that while modest efficiency gains can be realized during execution of the procedure, the largest efficiency gains will occur as a result of efficiencies in pre-job preparation and post-job closing activities, as well as the reduction of wait times and recovery from work stoppages and other events that introduce interruptions to the execution of work.
    - Pre-job briefs
    - Printing and preparation of paper work packages
    - Verification of M&TE
    - Auto-completion of Task Cover Sheet
    - Automated sign-on of jobs
    - Recovery from and/or elimination of job interruptions through enhanced communications (e.g., video streaming, automated job status updates, work re-plans)
    - Reduced wait time for support groups through automated statusing
    - Auto-calculation and auto-completion of data sheets
    - Field retrieval of supporting documents
- Reduction in human errors and subsequent activities related to processing of condition reports, analysis, and implementation of corrective actions. Most of the human error reduction opportunities are derived from MWP and CBP features that support field work execution.
- Reduction of administrative support
    - Printing and preparation of paper based work packages
    - Breakdown of packages
    - Retrieval of signatures
    - Archiving of records

A summary of labor savings by functional area is illustrated in *Figure 13* below, and by key work category in *Figure 14*.. A more detailed summary of labor savings at the task level is provided in Appendix D.

Figure 13. Labor Savings by Functional Area

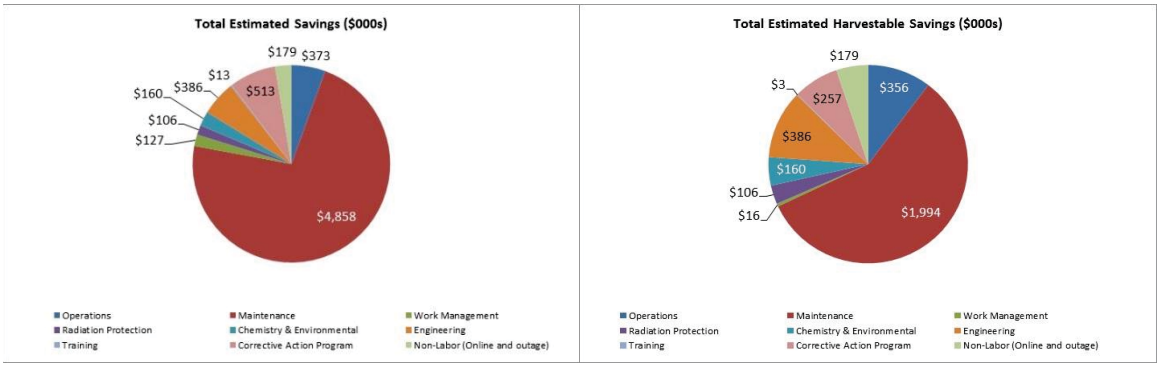


Figure 14. Labor Savings by Key Work Category

Labor Costs (Internal Labor, Overtime, Contractor Spend)								Approximate Base Organization Site Size (FTEs)			
Functional Area	Key Work Categories		Total Estimated Savings (person hrs)	Total Estimated Savings (x $1000)	Are savings harvestable? (Yes/No)	% Harvestable	Total Estimated Savings (FTEs)	1 Unit	2 Unit	3 Unit	Comments / Qualitative Benefits
Operations	OP.A.	Perform Field Operations	3,893	$ 288	Yes	100%	1.9	27	33	40	Most likely out of Ops OT
	OP.B.	Conduct Control Room Operations	-	$ -			0.0	30	40	50	
	OP.C.	Support Work Management	-	$ -			0.0	5	6	11	
	OP.D.	Perform Planning Activities	1,884	$ 85	Yes	80%	0.7	5	6	10	Ops support function
	OP.E.	Perform Support Activities	-	$ -			0.0	15	19	27	
	OP.F.	Participate in Training	-	$ -			0.0	11	14	20	
Maintenance	MA.A.	Perform Maintenance Activities	66,096	$ 3,913	Yes	30%	9.5	85	140	175	Qualified technician labor - assume mostly contractor spend and OT
	MA.B.	Support Work Management	-	$ -			0.0	4	7	9	
	MA.C.	Perform Planning Activities	12,375	$ 543	Yes	80%	4.8	18	30	37	Reduction in Planner time and Admin support for package preparation and post activity
	MA.D.	Perform Support Activities	4,342	$ 386	Yes	100%	2.1	22	37	46	Supervisor time spent (verify quals, sign-offs, etc.); Redeploy to offset other work filled by contractor during outages
	MA.E.	Participate in Training	272	$ 16	No	0%	0.0	10	16	20	Reduction in training hrs by 2% as a result of procedure automation
	MA.F.	Calibrate Maintenance & Test Equipme	-	$ -			0.0	2	3	4	
	MA.G.	Oversee Maintenance Program Implem	-	$ -			0.0	2	3	4	
Work Management	WM.A.	Manage Online Work	1,374	$ 102	No		0.0	9	10	13	Enabled by auto-reporting of status
	WM.B.	Manage Outage Work	212	$ 16	Yes	100%	0.1	6	7	9	Redeploy to offset other work filled by contractor
	WM.C.	Manage Risk and Safety	125	$ 9	No	0%	0.0	1	2	2	
	WM.D.	Perform Support Activities	-	$ -			0.0	5	8	11	
Radiation Protection	RP.A.	Provide job coverage	290	$ 17	Yes	100%	0.1	11	13	15	Offset of OT
	RP.B.	Maintain records	-	$ -			0.0	4	5	7	
	RP.C.	Maintain equipment	1,495	$ 88	Yes	100%	0.7	6	8	11	Offset of OT
	RP.D.	Package/control Radwaste	-	$ -			0.0	5	8	10	
	RP.E.	Plan Exposure of Jobs (ALARA)	-	$ -			0.0	4	6	8	
	RP.F.	Training Activities	-	$ -			0.0	5	7	9	
Chemistry & Environmental	CY.A.	Sample Systems	613	$ 36	Yes	100%	0.3	8	9	13	
	CY.B.	Data Evaluation and Trending	548	$ 32	Yes	100%	0.3	6	7	9	
	CY.C.	Operate and Maintain Equipment/Syste	1,728	$ 91	Yes	100%	0.8	2	2	3	
	CY.D.	RETS/REMP Program Monitoring	-	$ -			0.0	3	3	4	
	CY.E.	Training Activities	-	$ -			0.0	3	3	5	
Engineering	EN.A.	Perform Engineering activities	-	$ -			0.0	36	43	52	
	EN.B.	Monitor and report	4,350	$ 386	Yes	100%	2.1	15	17	19	
	EN.C.	Perform Support Activities	-	$ -			0.0	37	40	46	
	EN.D.	Training Activities	-	$ -			0.0	2	2	3	
Training	TR.A.	Conduct Training	-	$ -			0.0	21	25	28	
	TR.B.	Oversee Accreditation	-	$ -			0.0	6	7	8	
	TR.C.	Perform Support Activities	400	$ 13	Yes	25%	0.0	8	10	13	Offset of OT
	TR.D.	Training Activities	-	$ -			0.0	4	5	6	
Performance Improvement	PI.A.	Track and Trend Performance	-	$ -			0.0	4	5	7	
	PI.B.	Perform Support Activities	-	$ -			0.0	4	5	6	
Security & Access	SY.A.	Maintain Physical Security	-	$ -			0.0	180	190	200	
	SY.B.	Control Access Authorization	-	$ -			0.0	7	8	9	
	SY.C.	Oversee Maintenance Program Implem	-	$ -			0.0	5	6	7	
Procedures	PR.A.	Manage procedure/program document	-	$ -			0.0	10	13	16	
Emergency Preparedness	EP.A.	Develop and Conduct Drills	-	$ -			0.0	3	4	5	
	EP.B.	Perform Support Activities	-	$ -			0.0	2	3	4	
Corrective Action Program	CA.A.	Process Condition Reports	6,764	$ 513	Yes	50%	1.6	10	13	19	
	CA.B.	Monitor and manage records	-	$ -			0.0	5	7	8	
	Total Savings:		106,760	$ 6,536			25.1	673	855	1038	

Total Harvestable Annual Savings (person hrs)	Total Harvestable Annual Savings (x $1000)	Total Unharvestable Annual Savings (person hrs)	Total Unharvestable Annual Savings (x $1000)	Total Harvestable Savings (FTEs)
52,189	$ 3,278	54,571	$ 3,258	25

The key driver of non-labor savings are savings due to the elimination of paper work packages and the costs associated with consumables used to produce them.

Estimation of Present Value

For guidance purposes, a tool was added to the workbook to provide a quick estimate of NPV. As the cost of the technology was not evaluated, the NPV represents an estimate of the investment that will produce a net zero value for NPV. Assuming that the project benefits will not be fully realized until the third year of implementation at a discount rate of 10%, the net zero investment is approximately $22 million in present terms. In other words, the BCM shows that a technology deployment cost up to $22 million would be supported by the business case.

Figure 15. Net Zero NPV Investment Estimate

BCM NPV Estimating Tool

Discount Rate (Internal Rate of Return):		10%	
No. Years of Benefit:		15	years
Annual Benefit (Labor)	$	3.28	million
Annual Benefit (Non-Labor)	$	0.18	million
Annual Benefit (KPI)		n/a	million
Total Annual Benefit:	$	3.46	
First Year Realized Benefit:		3	
Estimated Net Zero NPV Investment:		$21.73	million

Human Performance Improvement

A major benefit of the MWP technology, in addition to improved work efficiency, is the reduction in human error. Many human error prevention techniques can be built into the MWP technologies in a transparent manner that actually reduces operator burden over having to observe implement these practices in a manual mode.

Many types of procedure use and adherence issues can be directly prevented. For example, skipping steps or performing steps out of order can be detected and controlled by the software. Other types of preventable errors include ensuring that the performer qualifications are current and that all test equipment matches what is required by the procedure and its calibration due date has not passed.

Human error prevention is also a form of cost savings in that it precludes rework, corrective action program requirements such as cause analysis and corrective actions, and regulatory impacts. The human error prevention features of the MWP could be just as strong a motivation to implement the technology as the labor savings.

Key Performance Indicators (KPIs)

Although new values for improved KPIs could not be calculated as part of this study, a number of KPIs are likely positively impacted by the MWP and CBP technology as follows:

- Production Cost ($/Megawatt-Hour) –due to direct reduction of O&M expense related to field work activities.
- Unplanned Reactor Trips – due to improved human performance during operational and maintenance activities, avoiding component identification errors and procedure use and adherence errors.
- Safety System Performance – due to shorter job durations enabled by the efficiency features of the technology. This reduces unavailability time on important safety systems.
- Forced Loss Rate – due to improved human performance during operational and maintenance activities, similar to Unplanned Reactor Trips.
- Unit Capability Factor – due to fewer human performance-related generation losses and the potential for shorter refueling outages due to improved work coordination.
- Radiation Exposure – due to shorter job durations for work conducted in radiation areas, and the potential to reduce the number of additional workers on a job because of certain technology features, such as remote concurrent verifications.

Best Practices and Recommendations

For the benefit of future use, the following recommendations can be applied to future use of the BCM:

1) In order to determine a more accurate figure on the average number of opportunities per work activity to study the efficiency and human performance features of the technology, the sample size of analyzed procedures should be increased to the extent possible.
2) Annotation and analysis of procedures in itself does not provide the level of understanding of how work is conducted needed to complete the BCMW. Field observations provide valuable insights to where the greatest inefficiencies exist and where MWP can have the greatest impact. It is recommended that field observations be conducted for a variety of work types for each functional area impacted by technology.
3) It is recommended that a senior manager of the operating station be designated as the project sponsor during the evaluation.
4) The project team must demonstrate a high degree of flexibility with respect to collection of data. Data requested is not always easily obtainable and proxy data may need to be considered.
5) Data received must be scrubbed to understand how the data were collected and what it actually represents. It is recommended that data be reviewed with subject matter experts to determine their validity. In many cases, expert judgment can yield more accurate information that the data.

6) Results of the BCM must be validated by the functional organizations that are impacted. This may require follow-up interviews with various levels within the organization.

Summary

The BCM was applied at a participating operating nuclear plant to evaluate the value of benefits of MWP. During the course of the study, several techniques for conducting analysis of work were developed and documented and improvements were made to the BCMW itself. The benefits of MWP were successfully quantified and the resulting NPV demonstrated that the continued development of the business case is warranted. In validating the BCM, the partner utility is provided with the basis for an internal business case for implementing this technology based on identified work efficiencies that are harvestable through reduced overtime and headcount reductions over time.

Through publication of the findings and the BCM, the nuclear industry is provided with a sample business case for pilot project technologies that can be used as a template for pursuing similar implementations at other nuclear plants.

Appendix A –Typical Features of Mobile Work Packages

Feature	Description
Correct Component Verification:	Use of bar codes, optical character recognition, RFIDs, computer vision, or other identification technologies to verify that the correct component has been identified to be worked on. This includes confirming this to the worker and confirming that the component matches the targeted component(s) listed in the computer-based work instructions.
Smart Place-Keeping:	Automatically take the performer to the next applicable step in the task sequence as well as automatically entering of performer identification (obtained by scanning the performer's employee badge) on the steps of a computerized procedure or work instruction. This includes recording the time of step execution. It prevents working steps out-of-order unless an authorized override function is invoked. Similar actions are performed for other users of the instructions, including concurrent and independent verifiers, quality control inspectors, and licensed operator authorizations.
Smart Branching:	Simplified step logic present conditional statements as binary questions to reduce the performer's mental workload. Based on the answer to the question the performer will be taken to the next applicable step while the steps not applicable are automatically marked as such.
Computational aids/verification:	Based on performer input, previous decisions made, and/or result from previous conducted steps calculations will be conducted automatically and the result will automatically be compared to the acceptable range. If result is out of range, the performer has to either correct the input used in the calculation or override the result.
Remote concurrent verifications:	Performer streams a video feed of the step execution, which is viewed concurrently (real-time) by the verifier. When step is complete, the verifier verifies the correct execution direct from his location. The performer's instruction (on the mobile device at the work site) is automatically updated with the verification and the performer moves on to the next step.
Detection of procedure conflicts:	Automatic tracking of active procedures and task status as well as real-time plant status updates (including lockout/tagouts). If a potential conflict is detected the performers will be warned and required to stop work until the conflict is resolved. Ultimately, the automation should be able to provide planners solution suggestion. The planners resolve the potential conflict and updated versions of instructions are pushed to the performers' devices.
Mode-sensitive procedures:	Access to the plant system ensures that the instruction/work order automatically updates to fit the current plant operating mode. If a conflict is detected between the task and the operating mode, the performer and planners will be notified.
Real-time data acquisition:	Automatic incorporation of operating mode, plant status (e.g., lock-out/tag-out), and other active procedures. Real-time updates as any parameter change and provide context sensitive information to the performer. Automatically guide the performer to the revised path of task execution.
Seamless transition to other procedures:	Automatically and seamlessly take the performer to the next applicable step even if the next step is in another procedure. If required, the performer has to read and acknowledge the prerequisites, limitations, and precautions for the new procedure before proceeding to the action step. When appropriate, the performer will automatically be brought back to applicable step in the original procedure.
Remote authorizations:	Automatic notifications to supervisors or other relevant staff lined up to conduct the authorization. The notification contains the relevant information (e.g., task, step, conditions, and photos) needed to conduct the authorization. When the authorization is made, the performer is automatically notified and allowed to proceed with the task.
Real-time work status updates:	Supervisors, work planners, independent verifiers, and others can receive real-time status updates for specific tasks, such as critical path items during an outage. We work instruction system sends automatic notifications with status updates when trigger points has been reached in the procedure.
Work coordination triggers:	Automatic notifications and hands offs between different organizations (e.g., control room operators and field workers) while performing a shared task. This provides a

Feature	Description
	smooth and efficient workflow with minimal delays due to communication lag.
Streamlined job preparation and pre-job brief:	Automatically tailored pre-job briefs to best prepare for task at hand. Provide just-in time training in forms of videos, photos, P&IDs, OE sheets, etc. to further aid in the preparation for the job.
Time-monitoring for time sensitive actions:	The work instruction provides aids, such as grouping if actions, visible time monitoring, and warnings to prepare the performer for and support the performer during time sensitive actions.
Monitoring for continuously applicable steps:	Automatically tracks continuous applicable steps and notifies the performer if conditions change in a manner that affects the step in any way. Also, provides reminders to check the continuously applicable step.
Verification of worker qualifications:	When logging on to the work instruction system the performer will provide identification in some manner, e.g., by scanning the barcode on his/her badge, enter name, or enter worker identification number. The performer's identification will be used to verify that the performer's qualifications match the requirements for the task at hand.
Verification of M&TE:	Automatically verify that the M&TE to be used to perform the task match the requirements for the task at hand. This will both ensure that the available equipment in correctly calibrated for the task.
Real-time access to reference documents and OE:	Easy access to drawings, OE sheets, and other reference documentations directly on the mobile device while at the work site in the plant. Documentation is linked to specific steps if relevant as well as at searchable and accessible at any time from the plant's document archive.
Real-time package modification:	If needed, validated modifications to the active work package can be pushed to the devices used to conduct the task. The performer will be notified by the change before continuing the task with the modified instruction.
Collaborating through video modification:	The performer streams a live video feed from the work site, which is viewed by others in remote locations. This is an efficient way for example, to assess unexpected conditions in the plant, monitoring the execution of a critical task, or performing a remote concurrent verification of a task performed in the field.
Real-time risk assessment:	Ability to assess the overall effect on plant risk of procedures and work packages in concurrent use, and as compared with the current and upcoming plant configuration. This includes detecting work activities on protected equipment, potential interaction of multiple work activities, and knowing the timing of critical steps in procedures relative to other plant conditions.
Plant situational awareness:	Ability of a work crew to know be aware of current or changing plant conditions that might affect their work. For example, a crew could be immediately aware of redundant equipment becoming unavailable and therefore would not subject the plant to further risk. Likewise, they could be immediately aware of changing conditions such as emergent safety hazards.

Appendix B – List of Representative Procedures

#	Title	Function	Work Type
1	Turbine Building Drain System Alignment	Ops	Surveillance
2	Liquid Waste Release	Ops	Ops - Field Ops
3	RCS Leakage Calculation	Ops	Surveillance
4	Main Turbine Bearing Oil Pumps Operability Test	Ops	Surveillance
5	Guidelines for Radiochemistry Data Review using Apex	Chem	Surveillance
6	Operation of DMRS Readout/Control Box (R/CB)	Chem	Operation
7	Management of DMRS Status and Parameters	Chem	Operation
8	Operation of the Unit 1 Nuclear Sampling System - Liquid	Chem	Chem - Sample & Analysis
9	92-day Battery and Charger Inspection and Maintenance	Maint	Surveillance
10	AGASTAT Timing Relay Calibration	Maint	Maint - PM
11	Crimping Cable Terminations and Splices	Maint	Maint - DM/Other
12	Torqueing Electrical Type Connections	Maint	Maint - CM
13	Heat Shrink Insulation for Control and Power Cable Splices and Terminations	Maint	Maint - DM/Other
14	Electrical Integrity and Configuration Control	Maint	Inspection
15	Plant Electrical Component Temporary Configuration Control	Maint	Maint - DC
16	Plant Electrical Component Temporary Configuration Control Documentation	Maint	Maint - DC
17	Bourdon Tube-Type Indicator Calibration	Maint	Surveillance
18	Pressure Switch Calibration	Maint	Surveillance
19	Testing of Safety-Related NSCW System Coolers	Maint	Surveillance
20	AOV Diagnostic Testing and Signature Evaluation	Maint	Surveillance
21	Control of Insulation Removal and Installation	Maint	Maint - DM/Other
22	Fisher Butterfly Valve Maintenance	Maint	Maint - PM
23	Grinnell Diaphragm Valve Maintenance	Maint	Maint - PM
24	Hills-McCanna Diaphragm Valve Maintenance	Maint	Maint - PM
25	Pacific Gate Valve Maintenance	Maint	Maint - PM
26	Whitey Ball Tip Needle Valve Maintenance	Maint	Maint - PM
27	Bolting and Torque Guidelines	Maint	Other
28	Actuated Valve Packing and Adjustment Procedure	Maint	Maint - DM/Other
29	Manual Valve Packing and Adjustment Procedure	Maint	Maint - DM/Other
30	Operation and Calibration of the AMP-100/200 Dose Rate Meter	RP	RP - O&M Equip
31	Operation and Calibration of the MGPI Telepole Instrument	RP	RP - O&M Equip
32	Airborne Radioactivity Sampling and Evaluation	RP	Surveillance

Appendix C – Adjusted Work Order Breakdown by Outage, Organization, and Type

Work Orders and Hours by Work Type Normalized for Outage Schedule

Work Type		No. of Work Orders									Hours Planned									Planned Hours per WO*								
		Elect	I&C	Mech	FIN	Ops	Craft	RP	Chem	Total	Elect	I&C	Mech	FIN	Ops	Craft	RP	Chem	Total	Elect	I&C	Mech	FIN	Ops	Craft	RP	Chem	Total
Online	Corrective Maint	83	75	90	280	1	2	1	1	530	920	640	1,400	3,000	16	34	0	0	6,010	11	9	16	11	16	16	0	0	16
	Deficient/Other	410	430	810	280	6	230	6	2	2,200	15,000	3,400	12,000	2,900	100	8,800	67	18	42,300	37	8	15	10	16	38	11	9	25
	Design Change	140	35	56	8	0	80	0	0	320	4,100	270	48	42	0	2,100	0	0	6,560	29	8	1	5	-	26	-	-	46
	Inspection	81	4	22	1	3,700	2	100	28	3,900	440	11	480	0	3,400	190	670	21	5,210	5	3	22	0	1	90	7	1	1
	Preventive Maint	1,000	1,100	1,100	23	4	14	6	2	3,200	12,000	11,000	14,000	170	25	460	78	13	37,700	12	10	13	7	6	33	12	6	15
	Surveillance	1,300	2,100	1,100	330	3,700	22	31	1,300	9,900	13,000	13,000	11,000	1,900	4,700	500	42	1,300	45,400	10	6	10	6	1	23	1	1	6
	Total	**3,000**	**3,700**	**3,200**	**920**	**7,400**	**350**	**140**	**1,300**	**20,100**	**45,500**	**28,300**	**38,900**	**8,010**	**8,240**	**12,100**	**857**	**1,350**	**143,000**	**15**	**8**	**12**	**9**	**1**	**35**	**6**	**1**	**9**
Outage	Corrective Maint	41	54	37	10	1	3	1	0	150	660	800	600	87	3	66	8	0	2,220	16	15	16	9	3	20	12	-	21
	Deficient/Other	190	180	390	3	0	450	3	1	1,200	5,200	4,000	9,300	63	0	17,000	32	0	35,600	27	22	24	19	-	38	10	0	28
	Design Change	49	25	23	1	1	73	1	0	170	740	190	11	0	0	1,400	0	0	2,340	15	8	0	0	0	19	0	-	41
	Inspection	0	1	5	0	0	1	0	0	7	0	1	40	0	0	10	0	0	51	-	1	8	-	-	8	-	-	7
	Preventive Maint	330	400	290	0	1	31	1	0	1,100	9,200	9,300	9,400	0	7	1,600	4	0	29,500	28	23	32	-	6	52	3	-	30
	Surveillance	67	200	62	0	170	1	1	5	510	1,900	3,500	800	0	160	0	0	5	6,370	28	18	13	-	1	0	0	1	14
	Total	**680**	**860**	**810**	**14**	**170**	**560**	**7**	**6**	**3,100**	**17,700**	**17,800**	**20,200**	**150**	**171**	**20,100**	**44**	**5**	**76,100**	**26**	**21**	**25**	**11**	**1**	**36**	**6**	**1**	**26**
Grand Total		**3,700**	**4,600**	**4,000**	**930**	**7,600**	**910**	**150**	**1,300**	**23,200**	**63,000**	**46,000**	**59,000**	**8,200**	**8,400**	**32,000**	**900**	**1,400**	**220,000**	**41**	**28**	**37**	**19**	**2**	**70**	**12**	**2**	**34**

All data rounded to representative significant digits.

Data reflects 2014 data, in which there were 2 outages, for 45 days each

With an 18 month cycle time, and 2 units, on an annual basis there are 1.33 planned outages/year
The adjustment factor for work orders for planned outages is therefore 0.667 (1.33/2)

In 2014, there were 104 total unit weeks, of which 92 were spent online
On an annual basis there should be 1.33 outages/year * 6 weeks/outage = 8 outage weeks per year
Therefore there should be 96 online unit weeks/year
The adjustment factor for work orders for online weeks is therefore 1.04348 (96/92)

*3,200 Work Orders with Planned Hours left blank and 660 Work Orders with 0 hours recorded were included for the purposes of calculating "Planned Hours per WO".
These Work Orders are assumed to be tasks that are unplanned and picked up on an ad hoc basis

Appendix D – Summary of Estimated Labor Savings at Task Level

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
1	OP.A.141.	Operations:	Perform Field Operations: > Conduct Pre-Job Brief	0.30	$47	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 7,600 Ops WOs x 2 workers for 10 minutes. Of that, estimated 50% of WOs require pre-job briefs with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
2	OP.A.135 b.	Operations:	Perform Field Operations: > Conduct surveillances and tests	0.30	$46	3,900 Surveillance WOs from WMS. Avg. planned hours for this work in WMS is just over 2 hours in duration. Estimate 8% time savings	General CBP features, especially remote notifications, data sheets, computations and verifications
3	OP.A.3.	Operations:	Perform Field Operations: > Hang tags	0.13	$19	25 tag outs per week @ 4 hours - potentially eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video
4	OP.A.4.	Operations:	Perform Field Operations: > Remove tags	0.13	$19	25 tag outs per week @ 4 hours - potentially eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video
5	OP.A.5.	Operations:	Perform Field Operations: > Conduct Post-Maintenance Tests	0.64	$98	Estimated as 40% of all Mech and Elect WO from WMS require post-maintenance tests. Each test estimated as 4 man-hours on average. Estimated 10% time savings.	Remote notifications to better coordinate time of service
6	OP.A.6.	Operations:	Perform Field Operations: > Operate Equipment/Systems	0.35	$54	Estimated as 20 operations performed per day @ 365 DPY with on average 1 man-hour for each operation. Estimated 10% time savings	General CBP features, especially those that enhance coordination with the Control Room
7	OP.A.145.	Operations:	Perform Field Operations: > Install/remove temp mods (instrumentation, jumpers) for testing/maintenance	0.03	$4	Estimated as 30% of Ops Surveillances	General CBP features, especially those that enhance coordination with the Control Room
8	OP.D.13.	Operations:	Perform Planning Activities: > Review/sign off on work packages	0.20	$37	7,600 Ops WOs in WMS get packages prepared. Estimated 10 minutes Supervisor time per Work Package and 33% time savings per WP	Automated routing and archiving
9	OP.D.46a.	Operations:	Perform Planning Activities: > Print and assemble work packages	0.35	$24	7,600 Ops Surveillances in WMS get packages prepared. Estimated 15 minutes Admin time per Work Package eliminated	Automated generation of MWP
10	OP.D.46b.	Operations:	Perform Planning Activities: > Process and archive completed work packages	0.35	$24	7,600 Ops Surveillances in WMS get packages prepared. Estimated 15 minutes Admin time per Work Package. Of those 25% will require some follow-up	Automation of archiving of records directly to Documentum
11	MA.A.139.	Maintenance:	Perform Maintenance Activities: > Obtain Pre-Job Brief	1.06	$130	Basis: Emphasis on critical steps and operating experience can be conveyed through the Work Package. Calculation: 13,200 Maint WOs x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
12	MA.A.35a.	Maintenance:	Perform Maintenance Activities:	1.90	$234	All WOs require some sort of sign-on. Of those 60% can be automated through remote sign-on	Remote sign-on

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
			> Initial sign-on of work			(eliminating waiting time in control center)	
13	MA.A.13.	Maintenance:	Perform Maintenance Activities: > Review/sign off on work packages	1.59	$195	Based on one Maint worker at 1/2 hour per close out. Estimated that there will be a 50% savings of work to close Maint WO	CBP features that ensure all steps and sign-offs and elimination of unused sections, verification of results, automation of data sheets, and automated routing for supervisor approval
14	MA.A.45b.	Maintenance:	Perform Maintenance Activities: > Replan work packages	0.32	$39	Estimated that 5% of WO need real-time replan resulting in delay of 1 hour for 2 field workers; eliminates 90% of delay	MWP features that allow real time markup and collaboration with planner
15	MA.A.23.	Maintenance:	Perform Maintenance Activities: > Conduct Correct Component verification	12.67	$1,560	Assumes 42% WO (20% Mech/FIN & 55% Elect/I&C) will no longer need second technician or helper if verifications can be done using barcode verification. Basis: 20% of all WO eliminate second worker who is needed solely for verification	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video
16	MA.A.26.	Maintenance:	Perform Maintenance Activities: > Sign in/out of clearances	0.25	$31	Assumes half of all Maint WO have (2) clearances actions sign-on/out. Of those, 10% have a tag lift. 2 people x min. 15 minutes to travel to clearance coordinator. Note: The overall sign-in/out is performed in the shop and is not impacted by WMP	MWP/CBP feature that enables remote sign-in/out of clearances from field location
17	MA.A.28.	Maintenance:	Perform Maintenance Activities: > Conduct field walkdown	1.19	$147	Assume 75% of WO require field walkdown, approx. 1 hour on average. 25% of time saved due to automatic/ remote retrieval of MWP, real-time markup in field, and automatic routing to the planner for corrections	MWP/CBP features that enable remote document access, markup, and routing to planner
18	MA.A.33a.	Maintenance:	Perform Maintenance Activities: > Verify M&TE	1.07	$132	Assumes 2 opportunities per WO eliminated saving approximately 10 minutes per opportunity. Eliminates need to compare M&TE calibration sticker with calibration database and to verify M&TE matches what is specified in procedure	Barcode and remote access to M&TE data
19	MA.A.36.	Maintenance:	Perform Maintenance Activities: > Execute field work including clean up area	10.14	$1,249	Based on separate study estimating efficiency for executable work of procedures. 13,200 maintenance procedures with avg. 14.4 planned hours per WO. Refer to separate MAINT Estimate Sheet	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC
20	MA.A.43.	Maintenance:	Perform Maintenance Activities: > Close out work orders/work requests in work management system	1.59	$195	Based on direct entry of closeout information (job start/complete times, actual man-hours and job comments) from MWP/CBP. 13,200 WO at 30 min per closeout 50% more efficient	MWP/CBP features that enable direct access to WMS
21	MA.C.45a.	Maintenance:	Perform Planning Activities: > Plan work packages	1.90	$264	Basis of 13,200 WO with an avg. of 2 hours per WO. Estimate 15% savings per plan due to improved ability to provide incorporate information obtained during field walkdown (includes walkdown time, interaction with craft)	MWP/CBP features that enable remote document access, field markup during planning walkdown
22	MA.C.45b.	Maintenance:	Perform Planning Activities: > Replan work packages	0.08	$11	Estimated that 5% of WO need real-time replan. Efficiency due to automatic notification and markups from field and routing back to field location	MWP features that allow real time markup and collaboration with planner
23	MA.C.46a.	Maintenance:	Perform Planning	1.59	$107	Assumes all packages will be able to be issued	MWP automated generation

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
			Activities: > Print and assemble work packages			as MWP. Roughly equivalent to 35% of Admin time	
24	MA.C.46b.	Maintenance:	Perform Planning Activities: > Process and archive completed work packages	2.38	$161	Assumes 25% of packages require some follow-up processing. Roughly equivalent to 65% of Admin time.	MWP automated processing archiving
25	MA.D.141.	Maintenance:	Perform Support Activities: > Conduct Pre-Job Brief	0.52	$97	Basis: Emphasis on critical steps and operating experience can be conveyed through the Work Package. Calculation: 13,200 Maint WOs x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
26	MA.D.140 b.	Maintenance:	Perform Support Activities: > Verify Qualifications	0.79	$147	This is a supervisor action that is eliminated due to auto-verification of quals during job initiation @ 5 minutes per worker	MWP/CBP access of remote databases
27	MA.D.136.	Maintenance:	Perform Support Activities: > Sign off work orders/procedures	0.52	$97	Efficiency due to direct routing to supervisors mobile platform and elimination of PU&A error checking	Automated routing and MWP/CBP features addressing human error (HU)
28	MA.D.59.	Maintenance:	Perform Support Activities: > Monitor work progress/execution	0.25	$46	Based on 3100 outage WO and 10% of Tech Spec-related online WOs	Real-time collaboration and direct viewing of MWP/CBP in progress as well as automated real-time status updates to schedule at predefined status points
29	MA.E.142.	Maintenance:	Participate in Training: > Participate in training	0.13	$16	2% reduction resulting from procedure automation. Based on 136 technicians x 100 hours/yr.; only the features that would reduce training elapsed time during training	CBP features that include smart-placekeeping, smart-branching, automated computations, and smart datasheets
30	WM.A.59.	Work Management:	Manage Online Work: > Monitor work progress/execution	0.66	$102	Basis is 20,100 on-line WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration
31	WM.B.59.	Work Management:	Manage Outage Work: > Monitor work progress/execution	0.10	$16	Basis is 3,100 outage WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration
32	WM.C.67.	Work Management:	Manage Risk and Safety: > Minimize emergent work risk	0.06	$9	Estimated 500 emergent work items per year requiring risk review with 1 hour to perform. Estimate 25% efficiency gain due to ability to collaborate real-time with multiple parties	Real-time collaboration and video streaming
33	RP.A.68.	Radiation Protection:	Provide job coverage: > RP dose monitoring/ dose measurements, samples etc.	0.14	$17	Reduction of 11% of the stay time during the execution portion only. Based on 2% of all maintenance WO (264 jobs) per year (approximately 2 per day)	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC
34	RP.C.133.	Radiation Protection:	Maintain equipment: > Calibrate equipment	0.02	$3	200 meters annual calibration @ 1 hour per calibration made 25% more efficient	Automated data-sheets; CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing
35	RP.C.74.	Radiation Protection:	Maintain equipment: > Routine surveys/surveillances	0.58	$71	Based on 33 surveys per day @ 1 hour each survey with 10% efficiency gain	Automated survey map markup features and editing in field

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
36	RP.C.135 b.	Radiation Protection:	Maintain equipment: > Conduct surveillances and tests	0.12	$14	Surveillances of radiation monitors (50 monitors per unit with monthly surveillance) @ w hours per surveillance made 10% more efficient. Source check, respiratory equipment kits, inventory of boxes with material, vacuum cleaners, etc.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing
37	CY.A.85.	Chemistry & Environmental:	Sample Systems: > Chemistry samples and analysis	0.21	$26	No of samples based on 6 samples per day, 365 days per week at 2 hours per sample. Sampling made 10% more efficient due to CBP	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications
38	CY.A.86.	Chemistry & Environmental:	Sample Systems: > Monitor effluent/environmental stations	0.08	$10	Approx. 12 environmental stations monitored daily at 1/2 hour each with 8% efficiency gain	Efficiencies due to automation of data sheets, automated computations, pre and post processing of procedures. Error elimination with use of bar codes at stations
39	CY.B.89.	Chemistry & Environmental:	Data Evaluation and Trending: > Data evaluation and trending of system	0.26	$32	Time to transfer sample data into trending system is eliminated (see CY-A-85 above)	Automated interface to databases
40	CY.C.90.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Maintain instrumentation	0.30	$37	Maintain DRMS Systems (PERMS - Plant Effluent Radiation Monitoring System) @ 60 hours per week made 20% more efficient due to CBP features	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications
41	CY.C.135 b.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Conduct surveillances and tests	0.05	$7	Based on 1,300 surveillance (from WMS data) at 1.1 hours per surveillance made 8% more efficient	General CBP features, especially those that enhance coordination with the Control Room
42	CY.C.46a.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Print and assemble work packages	0.12	$8	Approx. 1,000 Work Packages at 15 min each eliminated from work	MWP automated generation
43	CY.C.46b.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Process and archive completed work packages	0.18	$12	Approx. 1,000 Work Packages with 75% work time saved	MWP automated processing archiving
44	CY.C.6.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Operate Equipment/Systems	0.18	$27	In line monitors/equipment maintenance approx. 20 per day	General CBP features, especially those that enhance coordination with the Control Room
45	EN.B.96.	Engineering:	Monitor and report: > Trend data	2.09	$386	8,700 surveillance conducted for Elec, I&C, Mech, and Ops. Estimate 1/2 hour saved by engineering time spent processing data into trending databases (e.g., system health program)	Automated interface to databases
46	TR.C.46a.	Training:	Perform Support Activities: > Print and assemble work packages	0.19	$13	Estimated 200 training days x 6 disciplines (Elec, I&C, Mech, Ops, RP, and Chem) at 2 training activities requiring a package per day (2,400 packages)	Automated CBP generation
47	CA.A.126	Corrective	Process Condition	1.15	$178	Assumed 6,000 Condition Reports (CR) per	MWP/DBP features related to human error

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
	a.	Action Program:	Reports: > Processing condition reports			year for a 2 unit station. Estimate 4 hours per report and elimination of 10% of reports due to MWP/CBP features	reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
48	CA.A.126 b.	Corrective Action Program:	Process Condition Reports: > Conduct Corrective Actions for Condition Reports	1.44	$222	Assumed 3,000 condition reports result in required corrective actions. Estimate 10 hours per CR for corrective actions and elimination of 10% of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
49	CA.A.127.	Corrective Action Program:	Process Condition Reports: > Apparent Cause Evaluations	0.24	$37	Assumed 250 condition reports result in apparent cause evaluations. Estimate 20 hours per evaluation and elimination of 10% of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
50	CA.A.128.	Corrective Action Program:	Process Condition Reports: > Root Cause Evaluations	0.42	$77	Assumed 30 condition reports result in root cause evaluations. Estimate 720 hours per evaluation and elimination of 10% of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.

INL Business Case Methodology Workbook

Using the Methodology Workbook

1. Identify and describe below the project/technology being evaluated.
2. Identify below the type of impact the new technology may have on a site by checking the boxes next the options.
3. Identify the area of the site organization where those effects will appear.
4. Identify on the next tab, by area, which work drivers the new technology will have an effect on, and how future performance may differ.

Identifying the Project/Technology

Project Title: *BCM Validation*

Project Description: *Validate BCM by applying technology associated with electronic work packages to an existing site (Voglte 1 & 2)*

Number of Units

○ Single ◉ Double ○ Triple

☑ Labor Costs ☑ Non-Labor Costs ☑ Key Performance Indicators

Site Size:

☐ General	☑ Operations	☑ Maintenance	☑ Work Management
☑ Radiation	☑ Chemistry	☑ Engineering	☑ Training
☐ Performance	☐ Security and Access	☑ Procedures	☑ Corrective Action
☐ Health and Safety			

Identifying the Impact Type

Check the impact or impacts below you expect deployment of the new project/technology to have on a site.

Identifying the Impact Area

Check the impacted functional areas on a site.

INL Business Case Methodology Workbook

BCM NPV Estimating Tool

Discount Rate (Internal Rate of Return):		10%	
No. Years of Benefit:		15	years
Annual Benefit (Labor)	$	3.28	million
Annual Benefit (Non-Labor)	$	0.18	million
Annual Benefit (KPI)		n/a	million
Total Annual Benefit:	$	3.46	
First Year Realized Benefit:		3	
Estimated Net Zero NPV Investment:		$21.73	million

INL Business Case Methodology Workbook

Labor Costs (Internal Labor, Overtime, Contractor Spend)								Approximate Base Organization Site Size (FTEs)			
Functional Area	Key Work Categories		Total Estimated Savings (person hrs)	Total Estimated Savings (x $1000)	Are savings harvestable? (Yes/No)	% Harvestable	Total Estimated Savings (FTEs)	1 Unit	2 Unit	3 Unit	Comments / Qualitative Benefits
Operations	OP.A.	Perform Field Operations	3,893	$ 288	Yes	100%	1.9	27	33	40	Most likely out of Ops OT
	OP.B.	Conduct Control Room Operations	-	$ -			0.0	30	40	50	
	OP.C.	Support Work Management	-	$ -			0.0	5	6	11	
	OP.D.	Perform Planning Activities	1,884	$ 85	Yes	80%	0.7	5	6	10	Ops support function
	OP.E.	Perform Support Activities	-	$ -			0.0	15	19	27	
	OP.F.	Participate in Training	-	$ -			0.0	11	14	20	
Maintenance	MA.A.	Perform Maintenance Activities	66,096	$ 3,913	Yes	30%	9.5	85	140	175	Qualified technician labor - assume mostly contractor spend and OT
	MA.B.	Support Work Management	-	$ -			0.0	4	7	9	
	MA.C.	Perform Planning Activities	12,375	$ 543	Yes	80%	4.8	18	30	37	Reduction in Planner time and Admin support for package preparation and post activity
	MA.D.	Perform Support Activities	4,342	$ 386	Yes	100%	2.1	22	37	46	Supervisor time spent (verify quals, sign-offs, etc.); Redeploy to offset other work filled by contractor during outages
	MA.E.	Participate in Training	272	$ 16	No	0%	0.0	10	16	20	Reduction in training hrs by 2% as a result of procedure automation
	MA.F.	Calibrate Maintenance & Test Equipment	-	$ -			0.0	2	3	4	
	MA.G.	Oversee Maintenance Program Implemer	-	$ -			0.0	2	3	4	
Work Management	WM.A.	Manage Online Work	1,374	$ 102	No		0.0	9	10	13	Enabled by auto-reporting of status
	WM.B.	Manage Outage Work	212	$ 16	Yes	100%	0.1	6	7	9	Redeploy to offset other work filled by contractor
	WM.C.	Manage Risk and Safety	125	$ 9	No	0%	0.0	1	2	2	
	WM.D.	Perform Support Activities	-	$ -			0.0	5	8	11	
Radiation Protection	RP.A.	Provide job coverage	290	$ 17	Yes	100%	0.1	11	13	15	Offset of OT
	RP.B.	Maintain records	-	$ -			0.0	4	5	7	
	RP.C.	Maintain equipment	1,495	$ 88	Yes	100%	0.7	6	8	11	Offset of OT
	RP.D.	Package/control Radwaste	-	$ -			0.0	5	8	10	
	RP.E.	Plan Exposure of Jobs (ALARA)	-	$ -			0.0	4	6	8	
	RP.F.	Training Activities	-	$ -			0.0	5	7	9	
Chemistry & Environmental	CY.A.	Sample Systems	613	$ 36	Yes	100%	0.3	8	9	13	
	CY.B.	Data Evaluation and Trending	548	$ 32	Yes	100%	0.3	6	7	9	
	CY.C.	Operate and Maintain Equipment/Systen	1,728	$ 91	Yes	100%	0.8	2	2	3	
	CY.D.	RETS/REMP Program Monitoring	-	$ -			0.0	3	3	4	
	CY.E.	Training Activities	-	$ -			0.0	3	3	5	
Engineering	EN.A.	Perform Engineering activities	-	$ -			0.0	36	43	52	
	EN.B.	Monitor and report	4,350	$ 386	Yes	100%	2.1	15	17	19	
	EN.C.	Perform Support Activities	-	$ -			0.0	37	40	46	
	EN.D.	Training Activities	-	$ -			0.0	2	2	3	
Training	TR.A.	Conduct Training	-	$ -			0.0	21	25	28	
	TR.B.	Oversee Accreditation	-	$ -			0.0	6	7	8	

INL Business Case Methodology Workbook

Labor Costs (Internal Labor, Overtime, Contractor Spend)								Approximate Base Organization Site Size (FTEs)			
Functional Area	Key Work Categories	Total Estimated Savings (person hrs)	Total Estimated Savings (x $1000)	Are savings harvestable? (Yes/No)	% Harvestable	Total Estimated Savings (FTEs)	1 Unit	2 Unit	3 Unit	Comments / Qualitative Benefits
	TR.C. Perform Support Activities	400	$ 13	Yes	25%	0.0	8	10	13	Offset of OT
	TR.D. Training Activities	-	$ -			0.0	4	5	6	

INL Business Case Methodology Workbook

Labor Costs (Internal Labor, Overtime, Contractor Spend)								Approximate Base Organization Site Size (FTEs)			
Functional Area	Key Work Categories		Total Estimated Savings (person hrs)	Total Estimated Savings (x $1000)	Are savings harvestable? (Yes/No)	% Harvestable	Total Estimated Savings (FTEs)	1 Unit	2 Unit	3 Unit	Comments / Qualitative Benefits
Performance Improvement	PI.A.	Track and Trend Performance	-	$ -			0.0	4	5	7	
	PI.B.	Perform Support Activities	-	$ -			0.0	4	5	6	
Security & Access	SY.A.	Maintain Physical Security	-	$ -			0.0	180	190	200	
	SY.B.	Control Access Authorization	-	$ -			0.0	7	8	9	
	SY.C.	Oversee Maintenance Program Impleme	-	$ -			0.0	5	6	7	
Procedures	PR.A.	Manage procedure/program documents	-	$ -			0.0	10	13	16	
Emergency Preparedness	EP.A.	Develop and Conduct Drills	-	$ -			0.0	3	4	5	
	EP.B.	Perform Support Activities	-	$ -			0.0	2	3	4	
Corrective Action Program	CA.A.	Process Condition Reports	6,764	$ 513	Yes	50%	1.6	10	13	19	
	CA.B.	Monitor and manage records	-	$ -			0.0	5	7	8	
	Total Savings:		106,760	$ 6,536			25.1	673	855	1038	

Total Harvestable Annual Savings (person hrs)	Total Harvestable Annual Savings (x $1000)	Total Unharvestable Annual Savings (person hrs)	Total Unharvestable Annual Savings (x $1000)	Total Harvestable Savings (FTEs)
52,189	$ 3,278	54,571	$ 3,258	25

INL Business Case Methodology Workbook

									106,760		$ 6,536				
Labor Costs (Base Labor, Overtime, Contractor Spend)				**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**			
				Before		**Task Level Impact**									
Functional Area		Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)		
Operations	**OP.A.**	**Perform Field Operations**													
	OP.A.141.	Conduct Pre-Job Brief	Yes	7,600	0.33		100%	25%	633	Operator	$ 47	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 7,600 Ops work orders x 2 workers for 10 minutes. Of that, estimated 50% of WO require pre-job briefs with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)		
	OP.A.135a.	Conduct inspections/rounds	No												
	OP.A.135b.	Conduct surveillances and tests	Yes	3,900	2.00		100%	8%	624	Operator	$ 46	3900 Surveillance WOs from Maximo. Ave planned hours for this work in Maximo is just over 2 hour in duration. Estimate 8% time savings.	General CBP features, especially remote notifications, data sheets, computations and verifications		
	OP.A.1.	Operator actions (stroke valves, start pumps, realign systems, etc.)	No												
	OP.A.2.	Lift tags for testing	No												
	OP.A.3.	Hang tags	Yes	1,300	4.00		100%	5%	260	Operator	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.		
	OP.A.4.	Remove tags	Yes	1,300	4.00		100%	5%	260	Operator	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.		
	OP.A.5.	Conduct Post-Maintenance Tests	Yes	3,320	4.00		100%	10%	1328	Operator	$ 98	Estimated as 40% of all Mech and Elect WO from Maximo require post maintenance tests. Each test estimated as 4 man-hr on average. Estimated 10% time savings.	Remote notifications to better coordinate time of service.		
	OP.A.6.	Operate Equipment/Systems	Yes	7,300	1.00		100%	10%	730	Operator	$ 54	Estimated as 20 operations performed per day @ 365 DPY with on average 1 mhr for each operation. Estimated 10% time savings	General CBP features, especially those that enhance coordination with the Control Room		
	OP.A.7.	Conduct operability determinations	No												
	OP.A.8.	Create labels	No												
	OP.A.145.	Install/remove temp mods (instrumentation, jumpers) for testing/maintenance	Yes	1,170	0.50		100%	10%	59	Operator	$ 4	Estimated as 30% of Ops Surveillances.	General CBP features, especially those that enhance coordination with the Control Room		
	OP.A.149.	Fire watches	No												
	OP.A.9.	Log entries	No												
	OP.B.	**Conduct Control Room Operations**													
	OP.B.9.	Log entries	No												
	OP.B.10.	Monitor and operate control room													
	OP.B.11.	Activating/deactivating LCOs	No												
	OP.C.	**Support Work Management**													
	OP.C.137.	Provide input to work schedule (resources, quals, feedback, etc.)	No												
	OP.C.138.	Support emergent activity requests	No												
	OP.D.	**Perform Planning Activities**													

									106,760		$ 6,536			
Labor Costs (Base Labor, Overtime, Contractor Spend)				**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**		
				Before		**Task Level Impact**								
Functional Area	Key Work Categories and Tasks		Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)
	OP.D.13.	Review/sign off on work packages	Yes	7,600	0.17		100%	33%	422	Supervisor	$ 37	7600 Ops Work Orders in Maximo get packages prepared. Estimated 10 minutes Supervisor time per Work Package and 33% time savings per WP	Automated routing and archiving
	OP.D.46a.	Print and assemble work packages	Yes	3,900	0.25	75%			731	Admin	$ 24	7600 Ops Surveillances in Maximo get packages prepared. Estimated 15 minutes Admin time per Work Package eliminated.	Automated generation of mobile work packages
	OP.D.46b.	Process and archive completed work packages	Yes	3,900	0.25		100%	75%	731	Admin	$ 24	7600 Ops Surviellances in Maximo get packages prepared. Estimated 15 minutes Admin time per Work Package. Of those 25% will require some follow-up.	Automation of archiving of records directly to Documentum
	OP.D.14.	Create/manage staffing schedules	No										
	OP.D.15.	Create tags	No										
	OP.D.16.	Review/approve tags	No										
	OP.D.17.	Plan Work Order Tasks (e.g. PMT)	No										
	OP.E.	**Perform Support Activities**											
	OP.E.18.	Test/maintain fire systems	No										
	OP.E.19.	Support plant initiatives requiring SROs	No										
	OP.E.20.	Conduct observations and performance appraisals	No										
	OP.F.	**Participate in Training**											
	OP.F.142.	Participate in training	No										
	OP.F.21.	Provide input on training packages	No										

INL Business Case Methodology Workbook

								106,760		$ 6,536				
Labor Costs (Base Labor, Overtime, Contractor Spend)			**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**			
			Before		**Task Level Impact**									
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)		
Maintenance	**MA.A. Perform Maintenance Activities**													
	MA.A.139. Obtain Pre-Job Brief	Yes	13,200	0.67		100%	25%	2201	Craft/Tech	$ 130	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 13,200 maint work orders x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)		
	MA.A.35a. Initial sign-on of work	Yes	13,200	0.50	60%			3960	Craft/Tech	$ 234	All WO require some sort of sign-on. Of those 60% can be automated through remote sign-on (eliminating wating time in control center)	Remote sign-on		
	MA.A.13. Review/sign off on work packages	Yes	13,200	0.50		100%	50%	3300	Craft/Tech	$ 195	Based on one Maint worker at 1/2 hour per close out. Estimated that there will be a 50% savings of work to close Maint WO.	CBP features that ensure all steps and sign-offs and elimination of unused sections, verification of results, automation of data sheets, and automated routing for supervisor approval		
	MA.A.22. Complete Implemented Review (Planning Walkdown)	No												
	MA.A.45b. Replan work packages	Yes	13,200	2.00		5%	50%	660	Craft/Tech	$ 39	Estimated that 5% of WO need real-time replan resulting in delay of 1 hour for 2 field workers; eliminates 90% of delay	Mobile work package features that allow real time markup and collaboration with planner		
	MA.A.23. Conduct Correct Component verification	Yes	13,200	14.40		42%	33%	26345	Craft/Tech	$ 1,560	Assumes 42% WO (20% Mech/FIN & 55% Elect/I&C) will no longer need second technician or helper if verifications can be done using barcode verification. Basis: 20% of all WO eliminate second worker who is needed solely for verification	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.		
	MA.A.24. Label components	No												
	MA.A.25. Document materials entering work zone	No												
	MA.A.140b. Verify Qualifications	No												
	MA.A.26. Sign in/out of clearances	Yes	1,320	0.50		100%	80%	528	Craft/Tech	$ 31	Assumes half of all Maint WO have (2) clearances actions sign-on/out. Of those, 10% have a tag lift. 2 people x min. 15 minutes to travel to clearance coordinator. Note: The overall sign-in/out is performed in the shop and is not impacted by WMP	MWP/CBP feature that enables remote sign-in/out of clearances from field location.		
	MA.A.27. Obtain sign off from maintenance program owner (e.g., sign off on lifing plan from L&R program owner)	No												
	MA.A.28. Conduct field walkdown	Yes	13,200	1.00		75%	25%	2475	Craft/Tech	$ 147	Assume 75% of WO require field walkdown, approx 1 hr on average. 25% of time saved due to automatic/ remote retrieval of MWP, real-time markup in field, and automatic routing to the planner for corrections.	MWP/CBP features that enable remote document access, markup, and routing to planner.		
	MA.A.29. Stage work area (clean, install FME dams, etc.)	No												
	MA.A.30. Prep for shielding	No												
	MA.A.151. Refuel mobile equipment (generators, grading equipment, etc.)	No												
	MA.A.31. Stage materials for job	No												

								106,760		$ 6,536			
Labor Costs (Base Labor, Overtime, Contractor Spend)				**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**	
				Before		**Task Level Impact**							
Functional Area	Key Work Categories and Tasks		Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)
	MA.A.33a.	Verify M&TE	Yes	26,400	0.13		75%	90%	2228	Craft/Tech	$ 132	Assumes 2 opportunities per WO eliminated saving approximately 10 minutes per opportunity. Eliminates need to compare M&TE calabration sticker with calibration database and to verify M&TE matches what is specified in procedure.	Barcode and remote access to M&TE data
	MA.A.33.	Obtain materials from Stores	No										
	MA.A.34.	Prepare/hang personnel clearance	No										
	MA.A.35.	Complete Safe Work Verification (Mech & Electrical)	No										
	MA.A.36.	Execute field work including clean up area	Yes	13,200	14.40		100%	11%	21099	Craft/Tech	$ 1,249	Based on separate study estimating efficiency for executable work of procedures. 13,200 maintenance procedures with ave. 14.4 planned hrs per WO. Refer to separate MAINT Estimate Sheet	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC.
	MA.A.37.	Status jobs (esp. critical path)	No										
	MA.A.38.	Consult reference/training material	No										
	MA.A.39.	Monitor/record dose	No										
	MA.A.132.	Perform decontamination work	No										
	MA.A.40.	Validate/Witness QC hold-point inspections	No										
	MA.A.41.	Engineering hold points for witness/verification (e.g. core verification)	No										
	MA.A.42.	Conduct placekeeping in procedures	No									Included in MA.A.36.	
	MA.A.43.	Close out work orders/work requests in work management system	Yes	13,200	0.50		100%	50%	3300	Craft/Tech	$ 195	Based on direct entry of closeout information (job start/complete times, actual manhours and job comments) from MWP/CBP. 13,200 WO at 30 min per closeout 50% more efficient.	MWP/CBP features that enable direct access to work management system.
	MA.A.1.	Operator actions (stroke valves, start pumps, realign systems, etc.)	No										
	MA.A.44.	Return equipment to stores	No										
	MA.A.145.	Install/remove temp mods (instrumentation, jumpers) for testing/maintenance	No										
	MA.A.136.	Sign off work orders/procedures	No										
	MA.B.	**Support Work Management**											
	MA.B.137.	Provide input to work schedule (resources, quals, feedback, etc.)	No										
	MA.B.138.	Support emergent activity requests	No										
	MA.C.	**Perform Planning Activities**											
	MA.C.45a.	Plan work packages	Yes	13,200	2.00		100%	15%	3960	Planner	$ 264	Basis of 13,200 WO with an ave. of 2 hrs per WO. Estimate 15% savings per plan due to improved ability to provide incorporate information obtained during field walkdown (includes walkdown time, interaction with craft)	MWP/CBP features that enable remote document access, field markup during planning walkdown
	MA.C.45b.	Replan work packages	Yes	13,200	1.00		5%	25%	165	Planner	$ 11	Estimated that 5% of WO need real-time replan. Efficiency due to automatic notification and markups from field and routing back to field location.	Mobile work package features that allow real time markup and collaboration with planner
	MA.C.46a.	Print and assemble work packages	Yes	13,200	0.25	100%			3300	Admin	$ 107	Assumes all packages will be able to be issued as MWP. Roughly equivalent to 35% of Admin time	MWP automated generation

INL Business Case Methodology Workbook

							106,760		$ 6,536				
Labor Costs (Base Labor, Overtime, Contractor Spend)			**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**		
			Before		**Task Level Impact**								
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)	
	MA.C.46b. Process and archive completed work packages	Yes	13,200	0.50		100%	75%	4950	Admin	$ 161	Assumes 25% of packages require some followup processing.Roughly equivalent to 65% of Admin time.	MWP automated processing archiving	
	MA.C.47. Stock Stores	No											
	MA.D. Perform Support Activities												
	MA.D.141. Conduct Pre-Job Brief	Yes	13,200	0.33		100%	25%	1089	Supervisor	$ 97	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 13,200 maint work orders x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)	
	MA.D.48. Prepare quals list	No											
	MA.D.140a. Assign work to crews	No											
	MA.D.140b. Verify Qualifications	Yes	13,200	0.13	100%			1650	Supervisor	$ 147	This is a supervisor action that is eliminated due to auto-verification of quals during job initiation @ 5 min. per worker.	MWP/CBP access of remote databases.	
	MA.D.136. Sign off work orders/procedures	Yes	13,200	0.25		100%	33%	1089	Supervisor	$ 97	Efficiency due to direct routing to supervisors mobile platform and elimination of PU&A error checking.	Automated routing and MWP/CBP features addressing human error (HU).	
	MA.D.49. Document work history	No											
	MA.D.134. Establish vendor contracts	No											
	MA.D.59. Monitor work progress/execution	Yes	4,110	0.25		100%	50%	514	Supervisor	$ 46	Based on 3100 outage WO and 10% of Tech Spec-related online WOs.	Real-time collaboration and direct viewing of MWP/CBP in progress as well as automated real-time status updates to schedule at predefined status points	
	MA.E. Training Activities												
	MA.E.50. Update M&TE database	No											
	MA.E.142. Participate in training	Yes	136	100.00		100%	2%	272	Craft/Tech	$ 16	2% reduction resulting from procedure automation. Based on 136 technicians x 100 hrs/yr; only the features that would reduce training elapsed time during training.	CBP features that include smart-placekeeping, smart-branching, automated computations, and smart datasheets.	
	MA.E.51. OJT/TPE	No											
	MA.F. Calibrate Maintenance & Test Equipment												
	MA.F.133. Calibrate equipment	No											
	MA.G. Oversee Maintenance Program Implementation												
	MA.G.52. Develop fleet/industry aligned programs	No											
	MA.G.53. Manage/document program work (PM, lifting/rigging, Security programs, etc)	No											
	MA.G.54. Sign off on program work	No											

									106,760		$ 6,536			
Labor Costs (Base Labor, Overtime, Contractor Spend)			**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**			
			Before		**Task Level Impact**									
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)		
Work Management	**WM.A. Manage Online Work**													
	WM.A.55. Scope work for work week	No												
	WM.A.56. Develop Online Work Schedules	No												
	WM.A.57. Perform resource levelization	No												
	WM.A.58. Close out Work Orders	No												
	WM.A.62. Coordinate emergent activity requests	No												
	WM.A.146. Emergent parts delivery	No												
	WM.A.59. Monitor work progress/execution	Yes	20,100	0.08	80%	20%	50%	1374	WW Mgr	$ 102	Basis is 20,100 on-line WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration.		
	WM.A.61. Perform Post Work Week Critique	No												
	WM.B. Manage Outage Work													
	WM.B.63. Prepare Outage Readiness/Scope Outage	No												
	WM.B.64. Develop Outage Schedules	No												
	WM.B.57. Perform resource levelization	No												
	WM.B.58. Close out Work Orders	No												
	WM.B.62. Coordinate emergent activity requests	No												
	WM.B.146. Emergent parts delivery	No												
	WM.B.59. Monitor work progress/execution	Yes	3,100	0.08	80%	20%	50%	212	WW Mgr	$ 16	Basis is 3,100 outage WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration.		
	WM.B.60. Perform Outage Critique	No												
	WM.C. Manage Risk and Safety													
	WM.C.65. Manage risk management plans	No												
	WM.C.66. Conduct safety shutdown assessments	No												
	WM.C.67. Minimize emergent work risk	Yes	500	1.00		100%	25%	125	WW Mgr	$ 9	Estimated 500 emergent work items per year requiring risk review with 1 hr to perform. Estimate 25% efficiency gain due to ability to collaborate real-time with multiple parties.	Real-time collaboration and video streaming.		

									106,760		$ 6,536			
Labor Costs (Base Labor, Overtime, Contractor Spend)				**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**		
				Before		**Task Level Impact**								
Functional Area	Key Work Categories and Tasks		Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)
Radiation Protection	**RP.A.**	**Provide job coverage**											
	RP.A.141.	Conduct Pre-Job Brief	No										
	RP.A.68.	RP dose monitoring/ dose measurements, samples etc.	Yes	13,200	10.00		2%	11%	290	Craft/Tech	$ 17	Reduction of 11% of the stay time during the execution portion only. Based on 2% of all maintenance WO (264 jobs) per year (approximately 2 per day)	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC.
	RP.A.69.	RP contamination monitor alarm response	No										
	RP.A.147.	Personnel safety monitoring (confined space, air quality monitoring)	No										
	RP.A.132.	Perform decontamination work	No										
	RP.B.	**Maintain records**											
	RP.B.70.	Maintain dose records	No										
	RP.B.71.	Maintain records of job coverage	No										
	RP.B.72.	Issue TLDs	No										
	RP.B.73.	Issue electronic dosimeter	No										
	RP.C.	**Operate and Maintain Equipment**											
	RP.C.133.	Calibrate equipment	Yes	200	1.00		100%	25%	50	Craft/Tech	$ 3	200 meters annual calibration @ 1 hr per calibration made 25% more efficient.	Automated data-sheets; CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing.
	RP.C.75.	Issue equipment	No										
	RP.C.76.	Maintain respiratory protection	No										
	RP.C.74.	Routine surveys/surveillances	Yes	12,045	1.00		100%	10%	1205	Craft/Tech	$ 71	Based on 33 surveys per day @ 1 hr each survey with 10% efficiency gain	Automated survey map markup features and editing in field
	RP.C.135b.	Conduct surveillances and tests	Yes	1,200	2.00		100%	10%	240	Craft/Tech	$ 14	Surveillances of radiation monitors (50 monitors per unit with monthly surveillance) @ w hrs per surveillance made 10% more efficient. Source check, respitory equipment kits, inventory of boxes with material, vacuum cleaners, etc.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing.
	RP.C.77.	Maintain equipment	No										
	RP.D.	**Package/control Radwaste**											
	RP.D.78.	Handle/package radwaste	No										
	RP.D.79.	Ship/receive radwaste	No										
	RP.D.80.	Issue documentation	No										
	RP.E.	**Plan Exposure of Jobs (ALARA)**											
	RP.E.81.	Report ALARA activities	No										
	RP.E.82.	Plan ALARA activities/write RWP	No										
	RP.E.83.	Install/remove shielding	No										
	RP.E.84.	Plan RP Work Order Tasks	No										
	RP.E.132.	Perform decontamination work	No										
	RP.F.	**Training Activities**											
	RP.F.142.	Participate in training	No										
	RP.F.143.	Provide training	No										

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Labor Costs (Base Labor, Overtime, Contractor Spend)				Summary Impact		Impact Factors			106,760		$ 6,536	Other	
				Before		Task Level Impact			Estimated Savings				
Functional Area	Key Work Categories and Tasks		Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)
Chemistry & Environmental	**CY.A.**	**Sample Systems**											
	CY.A.85.	Chemistry samples and analysis	Yes	2,190	2.00		100%	10%	438	Craft/Tech	$ 26	No of samples based on 6 samples per day, 365 days per week at 2 hours per sample. Sampling made 10% more efficient due to CBP.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications.
	CY.A.86.	Monitor effluent/environmental stations	Yes	4,380	0.50		100%	8%	175	Craft/Tech	$ 10	Approx 12 environmental stations monitored daily at 1/2 hour each with 8% efficiency gain	Effieciencies due to automation of data sheets, automated computations, pre and post processing of procedures. Error elimination with use of bar codes at stations
	CY.A.87.	Maintain permits	No										
	CY.B.	**Data Evaluation and Trending**											
	CY.B.88.	Collection and monitoring of system performance metrics	No										
	CY.B.89.	Data evaluation and trending of system	Yes	2,190	0.25	100%			548	Craft/Tech	$ 32	Time to transfer sample data into trending system is eliminated (see CY-A-85 above).	Automated interface to databases.
	CY.C.	**Operate and Maintain Equipment/Systems**											
	CY.C.88.	Collection and monitoring of system performance metrics	No										
	CY.C.90.	Maintain instrumentation	Yes	52	60.00		100%	20%	624	Craft/Tech	$ 37	Maintain DRMS Systems (PERMS - Plant Effluent Radiation Monitoring System) @ 60 hrs per week made 20% more efficient due to CBP features.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications.
	CY.C.135b.	Conduct surveillances and tests	Yes	1,300	1.10		100%	8%	114	Craft/Tech	$ 7	Based on 1300 surveillance (from Maximo data) at 1.1 hrs per surveillance made 8% more efficient.	General CBP features, especially those that enhance coordination with the Control Room
	CY.C.6.	Operate Equipment/Systems	No									(PERFORMED BY OPS - INCLUDED IN OPS)	General CBP features, especially those that enhance coordination with the Control Room
	CY.C.46a.	Print and assemble work packages	Yes	1,000	0.25	100%			250	Admin	$ 8	Approx 1000 work packages at 15min each eliminated from work	MWP automated generation
	CY.C.46b.	Process and archive completed work packages	Yes	1,000	0.50		100%	75%	375	Admin	$ 12	Approx 1000 work packages with 75% work time saved	MWP automated processing archiving
	CY.C.6.	Operate Equipment/Systems	Yes	7,300	0.50		100%	10%	365	Operator	$ 27	In line monitors/equipment maint maintenance approx 20 per day	General CBP features, especially those that enhance coordination with the Control Room
	CY.D.	**RETS/REMP Program Monitoring**											
	CY.D.91.	Monitor environment	No										
	CY.D.86.	Monitor effluent/environmental stations	No										
	CY.E.	**Training Activites**											
	CY.E.142.	Participate in training	No										
	CY.E.143.	Provide training	No										
Engineering	**EN.A.**	**Perform Engineering activities**											
	EN.A.144.	Perform calculations	No										
	EN.A.92.	Design Modifications/Change Requests	No										
	EN.A.100.	Walk down systems	No										
	EN.A.103.	Perform Probabilistic Risk Analysis	No										

INL Business Case Methodology Workbook

							106,760		$ 6,536				
Labor Costs (Base Labor, Overtime, Contractor Spend)			**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**		
			Before		**Task Level Impact**								
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)	
	EN.A.94. Update drawings	No											
	EN.A.150. Buried pipe location	No											
	EN.B. Monitor and report												
	EN.B.96. Trend data	Yes	8,700	0.50	100%			4350	Mgr/Engr	$ 386	8700 surveillance conducted for Elec, I&C, Mech, and Ops. Estimate 1/2 hour saved by engineering time spent processing data into trending databases (e.g., system health program).	Automated interface to databases.	
	EN.B.97. Evaluate data	No											
	EN.B.95. Develop health reports	No											
	EN.C. Perform Support Activities												
	EN.C.98. Review operating experience	No											
	EN.C.93. Oversee contractor modifications/calculations	No											
	EN.C.99. Participate in troubleshooting activities	No											
	EN.C.101. Resolve WO/WRs On Hold	No											
	EN.C.102. Participate in Operability Determinations	No											
	EN.C.152. Maintain equipment database	No											
	EN.D. Training Activities												
	EN.D.142. Participate in training	No											
	EN.D.104. Conduct NDE/ISI/RT/UT Exams	No											

INL Business Case Methodology Workbook

								106,760		$ 6,536				
Labor Costs (Base Labor, Overtime, Contractor Spend)			**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**			
			Before		**Task Level Impact**									
Functional Area	Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)		
Training	**TR.A. Conduct Training**													
	TR.A.108. Analyze training needs	No												
	TR.A.109. Design classes	No												
	TR.A.110. Instruct classes	No												
	TR.A.111. Evaluate trainees (develop/supervise exams)	No												
	TR.B. Oversee Accreditation													
	TR.B.106. Manage training database	No												
	TR.B.107. Manage accreditation programs/reports	No												
	TR.C. Perform Support Activities													
	TR.C.134. Establish vendor contracts	No												
	TR.C.105. Maintain simulator	No												
	TR.C.112. Manage regulatory relationships	No												
	TR.C.113. Maintain learning technology	No												
	TR.C.46a. Print and assemble work packages	Yes	2,400	0.17	100%			400	Admin	$ 13	Estimated 200 training days x 6 disciplines (Elec, I&C, Mech, Ops, RP, and Chem) at 2 training activities requiring a package per day (2,400 packages)	Automated CBP generation		
	TR.D. Training Activites													
	TR.D.142. Participate in training	No												
Performance Improvement	**PI.A. Track and Trend Performance**													
	PI.A. 114. Track and Report on performance indicators	No												
	PI.A. 117. Track and Report on Safety	No												
	PI.B. Perform Support Activities													
	PI.B.115. Support internal initiatives (site projects, etc)	No												
	PI.B.116. Participate in external initiatives (industry benchmarking, assessments, etc)	No												
Security & Access Authorization	**SY.A. Maintain Physical Security**													
	SY.A.118. Conduct rounds	No												
	SY.A.119. Stand watch	No												
	SY.A.148. Security compensatory actions (breached security barriers)	No												
	SY.A.149. Fire watches	No												
	SY.B. Control Access Authorization													
	SY.B.120. Issue site/contractor badges	No												
	SY.B.121. Conduct random drug tests	No												
	SY.C. Oversee Maintenance Program Implementation													
	SY.B.52. Develop fleet/industry aligned programs	No												
	SY.B.53. Manage/document program work (PM, lifting/rigging, Security programs, etc)	No												
	SY.B.54. Sign off on program work	No												
Procedures	**PR.A. Manage procedure/program documents**													
	PR.A.122. Create procedure/program documents	No												
	PR.A.123. Review procedures/program documents	No												
	PR.A.124. Issue procedure/program documents	No												

												106,760		$ 6,536					
Labor Costs (Base Labor, Overtime, Contractor Spend)				**Summary Impact**		**Impact Factors**			**Estimated Savings**			**Other**							
				Before		**Task Level Impact**													
Functional Area		Key Work Categories and Tasks	Impacted?	How Many Times Task Performed?	Ave. Time to Complete Task (hrs)	% Reduction in Number of Times Task Performed	% Tasks Impacted by Technology	% Time Saved Each Time Task Performed	Estimated Savings (person hrs)	Labor Type (Select)	Estimated Annual Dollar Savings (x $1000)	Comments / Qualitative Benefits	Key Enabling Technology(s)						
Corrective Action Program	**CA.A.**	**Process Condition Reports**																	
	CA.A.125.	Manage/administer investigation (e.g. PI)	No																
	CA.A.126a.	Processing condition reports	Yes	6,000	4.00	10%			2400	Craft Tech Support	$ 178	Assumed 6,000 Condition Reports (CR) per year for a 2 unit station. Estimate 4 hrs per report and elimination of 10 percent of reports due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.						
	CA.A.126b.	Conduct Corrective Actions for Condition Reports	Yes	3,000	10.00	10%			3000	Craft Tech Support	$ 222	Assumed 3,000 condition reports result in required corrective actions. Estimate 10 hrs per CR for corrective actions and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.						
	CA.A.127.	Apparent Cause Evaluations	Yes	250	20.00	10%			500	Craft Tech Support	$ 37	Assumed 250 condition reports result in apparent cause evaluations. Estimate 20 hrs per evaluation and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.						
	CA.A.128.	Root Cause Evaluations	Yes	12	720.00	10%			864	Mgr/Engr	$ 77	Assumed 30 condition reports result in root cause evaluations. Estimate 720 hrs per evaluation and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.						
	CA.A.129.	Employee Investigations																	
	CA.B.	**Monitor and manage records**																	
	CA.B.130.	Conduct trending analysis	No																
	CA.B.131.	Screen condition records	No																

Labor Cost Savings Summary Report

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
1	OP.A.141.	Operations:	Perform Field Operations: > Conduct Pre-Job Brief	0.30	$ 47	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 7,600 Ops work orders x 2 workers for 10 minutes. Of that, estimated 50% of WO require pre-job briefs with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
2	OP.A.135b.	Operations:	Perform Field Operations: > Conduct surveillances and tests	0.30	$ 46	3900 Surveillance WOs from Maximo. Ave planned hours for this work in Maximo is just over 2 hour in duration. Estimate 8% time savings.	General CBP features, especially remote notifications, data sheets, computations and verifications
3	OP.A.3.	Operations:	Perform Field Operations: > Hang tags	0.13	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.
4	OP.A.4.	Operations:	Perform Field Operations: > Remove tags	0.13	$ 19	25 tag outs per week @ 4 hours - potentialy eliminate second operator due to CV	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.
5	OP.A.5.	Operations:	Perform Field Operations: > Conduct Post-Maintenance Tests	0.64	$ 98	Estimated as 40% of all Mech and Elect WO from Maximo require post maintenance tests. Each test estimated as 4 man-hr on average. Estimated 10% time savings.	Remote notifications to better coordinate time of service.
6	OP.A.6.	Operations:	Perform Field Operations: > Operate Equipment/Systems	0.35	$ 54	Estimated as 20 operations performed per day @ 365 DPY with on average 1 mhr for each operation. Estimated 10% time savings	General CBP features, especially those that enhance coordination with the Control Room
7	OP.A.145.	Operations:	Perform Field Operations: > Install/remove temp mods (instrumentation, jumpers) for testing/maintenance	0.03	$ 4	Estimated as 30% of Ops Surveillances.	General CBP features, especially those that enhance coordination with the Control Room
8	OP.D.13.	Operations:	Perform Planning Activities: > Review/sign off on work packages	0.20	$ 37	7600 Ops Work Orders in Maximo get packages prepared. Estimated 10 minutes Supervisor time per Work Package and 33% time savings per WP	Automated routing and archiving
9	OP.D.46a.	Operations:	Perform Planning Activities: > Print and assemble work packages	0.35	$ 24	7600 Ops Surveillances in Maximo get packages prepared. Estimated 15 minutes Admin time per Work Package eliminated.	Automated generation of mobile work packages
10	OP.D.46b.	Operations:	Perform Planning Activities: > Process and archive completed work packages	0.35	$ 24	7600 Ops Surviellances in Maximo get packages prepared. Estimated 15 minutes Admin time per Work Package. Of those 25% will require some follow-up.	Automation of archiving of records directly to Documentum
11	MA.A.139.	Maintenance:	Perform Maintenance Activities: > Obtain Pre-Job Brief	1.06	$ 130	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 13,200 maint work orders x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
12	MA.A.35a.	Maintenance:	Perform Maintenance Activities: > Initial sign-on of work	1.90	$ 234	All WO require some sort of sign-on. Of those 60% can be automated through remote sign-on (eliminating wating time in control center)	Remote sign-on
13	MA.A.13.	Maintenance:	Perform Maintenance Activities: > Review/sign off on work packages	1.59	$ 195	Based on one Maint worker at 1/2 hour per close out. Estimated that there will be a 50% savings of work to close Maint WO.	CBP features that ensure all steps and sign-offs and elimination of unused sections, verification of results, automation of data sheets, and automated routing for supervisor approval
14	MA.A.45b.	Maintenance:	Perform Maintenance Activities: > Replan work packages	0.32	$ 39	Estimated that 5% of WO need real-time replan resulting in delay of 1 hour for 2 field workers; eliminates 90% of delay	Mobile work package features that allow real time markup and collaboration with planner
15	MA.A.23.	Maintenance:	Perform Maintenance Activities: > Conduct Correct Component verification	12.67	$ 1,560	Assumes 42% WO (20% Mech/FIN & 55% Elect/I&C) will no longer need second technician or helper if verifications can be done using barcode verification. Basis: 20% of all WO eliminate second worker who is needed solely for verification	MWP/CBP features that verify correct component and other performer actions such as computations. Could also rely on remote verifications through streaming video.
16	MA.A.26.	Maintenance:	Perform Maintenance Activities: > Sign in/out of clearances	0.25	$ 31	Assumes half of all Maint WO have (2) clearances actions sign-on/out. Of those, 10% have a tag lift. 2 people x min. 15 minutes to travel to clearance coordinator. Note: The overall sign-in/out is performed in the shop and is not impacted by WMP	MWP/CBP feature that enables remote sign-in/out of clearances from field location.
17	MA.A.28.	Maintenance:	Perform Maintenance Activities: > Conduct field walkdown	1.19	$ 147	Assume 75% of WO require field walkdown, approx 1 hr on average. 25% of time saved due to automatic/ remote retrieval of MWP, real-time markup in field, and automatic routing to the planner for corrections.	MWP/CBP features that enable remote document access, markup, and routing to planner.
18	MA.A.33a.	Maintenance:	Perform Maintenance Activities: > Verify M&TE	1.07	$ 132	Assumes 2 opportunities per WO eliminated saving approximately 10 minutes per opportunity. Eliminates need to compare M&TE calabration sticker with calibration database and to verify M&TE matches what is specified in procedure.	Barcode and remote access to M&TE data
19	MA.A.36.	Maintenance:	Perform Maintenance Activities: > Execute field work including clean up area	10.14	$ 1,249	Based on separate study estimating efficiency for executable work of procedures. 13,200 maintenance procedures with ave. 14.4 planned hrs per WO. Refer to separate MAINT Estimate Sheet	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC.
20	MA.A.43.	Maintenance:	Perform Maintenance Activities: > Close out work orders/work requests in work management system	1.59	$ 195	Based on direct entry of closeout information (job start/complete times, actual manhours and job comments) from MWP/CBP. 13,200 WO at 30 min per closeout 50% more efficient.	MWP/CBP features that enable direct access to work management system.
21	MA.C.45a.	Maintenance:	Perform Planning Activities: > Plan work packages	1.90	$ 264	Basis of 13,200 WO with an ave. of 2 hrs per WO. Estimate 15% savings per plan due to improved ability to provide incorporate information obtained during field walkdown (includes walkdown time, interaction with craft)	MWP/CBP features that enable remote document access, field markup during planning walkdown
22	MA.C.45b.	Maintenance:	Perform Planning Activities: > Replan work packages	0.08	$ 11	Estimated that 5% of WO need real-time replan. Efficiency due to automatic notification and markups from field and routing back to field location.	Mobile work package features that allow real time markup and collaboration with planner
23	MA.C.46a.	Maintenance:	Perform Planning Activities: > Print and assemble work packages	1.59	$ 107	Assumes all packages will be able to be issued as MWP. Roughly equivalent to 35% of Admin time	MWP automated generation
24	MA.C.46b.	Maintenance:	Perform Planning Activities: > Process and archive completed work packages	2.38	$ 161	Assumes 25% of packages require some followup processing.Roughly equivalent to 65% of Admin time.	MWP automated processing archiving
25	MA.D.141.	Maintenance:	Perform Support Activities: > Conduct Pre-Job Brief	0.52	$ 97	Basis: Emphasis on critical steps and operating experience can be conveyed through the work package. Calculation: 13,200 maint work orders x 2 workers for 20 minutes with 25% time savings	Control of steps and operator responses in a Computer Based Procedure (CBP) (e.g., JIT OE in pop-up window)
26	MA.D.140b.	Maintenance:	Perform Support Activities: > Verify Qualifications	0.79	$ 147	This is a supervisor action that is eliminated due to auto-verification of quals during job initiation @ 5 min. per worker.	MWP/CBP access of remote databases.
27	MA.D.136.	Maintenance:	Perform Support Activities: > Sign off work orders/procedures	0.52	$ 97	Efficiency due to direct routing to supervisors mobile platform and elimination of PU&A error checking.	Automated routing and MWP/CBP features addressing human error (HU).
28	MA.D.59.	Maintenance:	Perform Support Activities: > Monitor work progress/execution	0.25	$ 46	Based on 3100 outage WO and 10% of Tech Spec-related online WOs.	Real-time collaboration and direct viewing of MWP/CBP in progress as well as automated real-time status updates to schedule at predefined status points

INL Business Case Methodology Workbook

Labor Cost Savings Summary Report

#	Task Number	Functional Area	Work Category: Task	Est FTE Savings	Est Labor Savings (x $1,000)	Basis for Calculation	Key Enabling Technologies
29	MA.E.142.	Maintenance:	Participate in Training: > Participate in training	0.13	$ 16	2% reduction resulting from procedure automation. Based on 136 technicians x 100 hrs/yr; only the features that would reduce training elapsed time during training.	CBP features that include smart-placekeeping, smart-branching, automated computations, and smart datasheets.
30	WM.A.59.	Work Management:	Manage Online Work: > Monitor work progress/execution	0.66	$ 102	Basis is 20,100 on-line WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration.
31	WM.B.59.	Work Management:	Manage Outage Work: > Monitor work progress/execution	0.10	$ 16	Basis is 3,100 outage WO at 5 minutes of monitoring each. 80% of the work can be passively monitored due to auto-statusing. Of the remaining 20%, task is 50% more efficient due to real-time collaboration	Automated work statusing and real-time collaboration.
32	WM.C.67.	Work Management:	Manage Risk and Safety: > Minimize emergent work risk	0.06	$ 9	Estimated 500 emergent work items per year requiring risk review with 1 hr to perform. Estimate 25% efficiency gain due to ability to collaborate real-time with multiple parties.	Real-time collaboration and video streaming.
33	RP.A.68.	Radiation Protection:	Provide job coverage: > RP dose monitoring/ dose measurements, samples etc.	0.14	$ 17	Reduction of 11% of the stay time during the execution portion only. Based on 2% of all maintenance WO (264 jobs) per year (approximately 2 per day)	CBP features that include smart-placekeeping, smart-branching, automated computations, automated notifications, remote authorizations, remote access of reference information and documents, and real-time coordination of support groups such as QC.
34	RP.C.133.	Radiation Protection:	Maintain equipment: > Calibrate equipment	0.02	$ 3	200 meters annual calibration @ 1 hr per calibration made 25% more efficient.	Automated data-sheets; CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing.
35	RP.C.74.	Radiation Protection:	Maintain equipment: > Routine surveys/surveillances	0.58	$ 71	Based on 33 surveys per day @ 1 hr each survey with 10% efficiency gain	Automated survey map markup features and editing in field
36	RP.C.135b.	Radiation Protection:	Maintain equipment: > Conduct surveillances and tests	0.12	$ 14	Surveillances of radiation monitors (50 monitors per unit with monthly surveillance) @ w hrs per surveillance made 10% more efficient. Source check, respitory equipment kits, inventory of boxes with material, vacuum cleaners, etc.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, and automated routing.
37	CY.A.85.	Chemistry & Environmental:	Sample Systems: > Chemistry samples and analysis	0.21	$ 26	No of samples based on 6 samples per day, 365 days per week at 2 hours per sample. Sampling made 10% more efficient due to CBP.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications.
38	CY.A.86.	Chemistry & Environmental:	Sample Systems: > Monitor effluent/environmental stations	0.08	$ 10	Approx 12 environmental stations monitored daily at 1/2 hour each with 8% efficiency gain	Effieciencies due to automation of data sheets, automated computations, pre and post processing of procedures. Error elimination with use of bar codes at stations
39	CY.B.89.	Chemistry & Environmental:	Data Evaluation and Trending: > Data evaluation and trending of system	0.26	$ 32	Time to transfer sample data into trending system is eliminated (see CY-A-85 above).	Automated interface to databases.
40	CY.C.90.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Maintain instrumentation	0.30	$ 37	Maintain DRMS Systems (PERMS - Plant Effluent Radiation Monitoring System) @ 60 hrs per week made 20% more efficient due to CBP features.	CBP features especially of smart datasheets, automated computations, smart branching, automated notifications, automated routing, automated component verification, access to reference information, and remote ops notifications.
41	CY.C.135b.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Conduct surveillances and tests	0.05	$ 7	Based on 1300 surveillance (from Maximo data) at 1.1 hrs per surveillance made 8% more efficient.	General CBP features, especially those that enhance coordination with the Control Room
42	CY.C.46a.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Print and assemble work packages	0.12	$ 8	Approx 1000 work packages at 15min each eliminated from work	MWP automated generation
43	CY.C.46b.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Process and archive completed work packages	0.18	$ 12	Approx 1000 work packages with 75% work time saved	MWP automated processing archiving
44	CY.C.6.	Chemistry & Environmental:	Operate and Maintain Equipment/Systems: > Operate Equipment/Systems	0.18	$ 27	In line monitors/equipment maint maintenance approx 20 per day	General CBP features, especially those that enhance coordination with the Control Room
45	EN.B.96.	Engineering:	Monitor and report: > Trend data	2.09	$ 386	8700 surveillance conducted for Elec, I&C, Mech, and Ops. Estimate 1/2 hour saved by engineering time spent processing data into trending databases (e.g., system health program).	Automated interface to databases.
46	TR.C.46a.	Training:	Perform Support Activities: > Print and assemble work packages	0.19	$ 13	Estimated 200 training days x 6 disciplines (Elec, I&C, Mech, Ops, RP, and Chem) at 2 training activities requiring a package per day (2,400 packages)	Automated CBP generation
47	CA.A.126a.	Corrective Action Program:	Process Condition Reports: > Processing condition reports	1.15	$ 178	Assumed 6,000 Condition Reports (CR) per year for a 2 unit station. Estimate 4 hrs per report and elimination of 10 percent of reports due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
48	CA.A.126b.	Corrective Action Program:	Process Condition Reports: > Conduct Corrective Actions for Condition Reports	1.44	$ 222	Assumed 3,000 condition reports result in required corrective actions. Estimate 10 hrs per CR for corrective actions and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
49	CA.A.127.	Corrective Action Program:	Process Condition Reports: > Apparent Cause Evaluations	0.24	$ 37	Assumed 250 condition reports result in apparent cause evaluations. Estimate 20 hrs per evaluation and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
50	CA.A.128.	Corrective Action Program:	Process Condition Reports: > Root Cause Evaluations	0.42	$ 77	Assumed 30 condition reports result in root cause evaluations. Estimate 720 hrs per evaluation and elimination of 10 percent of CRs due to MWP/CBP features	MWP/DBP features related to human error reduction, such as smart data sheets, automated computations, smart placekeeping, automated component verification, etc.
			Total:	**51 FTE**	**$ 6.5**	**million annually (Note: Approximately 50% of this figure is harvestable)**	

	Common Tasks	Functional Area	% Units Saved	% Time Saved
1	Operator actions (stroke valves, start pumps, realign systems, etc.)	OP		
2	Lift tags for testing	OP		
3	Hang tags	OP		
4	Remove tags	OP		
5	Conduct Post-Maintenance Tests	OP		
6	Operate Equipment/Systems	OP		
7	Conduct operability determinations	OP		
8	Create labels	OP		
9	Log entries	OP		
10	Monitor and operate control room	OP		
11	Activating/deactivating LCOs	OP		
12	Support surveillance tests	OP		
13	Review/sign off on work packages	OP		
14	Create/manage staffing schedules	OP		
15	Create tags	OP		
16	Review/approve tags	OP		
17	Plan Work Order Tasks (e.g. PMT)	OP		
18	Test/maintain fire systems	OP		
19	Support plant initiatives requiring SROs	OP		
20	Conduct observations and performance appraisals	OP		
21	Provide input on training packages	OP		
22	Complete Implemented Review (Planning Walkdown)	MA		
23	Conduct Correct Component verification	MA		
24	Label components	MA		
25	Document materials entering work zone	MA		
26	Sign in/out of clearances	MA		
27	Obtain sign off from maintenance program owner (e.g., sign off on lifing plan from L&R program owner)	MA		
28	Conduct field walkdown	MA		
29	Stage work area (clean, install FME dams, etc.)	MA		
30	Prep for shielding	MA		
31	Stage materials for job	MA		
32	Obtain equipment from tool room	MA		
33	Obtain materials from Stores	MA		
33a	Verify M&TE	MA		
34	Prepare/hang personnel clearance	MA, OP		
35	Complete Safe Work Verification (Mech & Electrical)	MA		
35a	Initial sign-on of work	MA, OP		
36	Execute field work including clean up area	MA		
37	Status jobs (esp. critical path)	MA		
38	Consult reference/training material	MA		
39	Monitor/record dose	MA		
40	Validate/Witness QC hold-point inspections	MA		
41	Engineering hold points for witness/verification (e.g. core verification)	MA		
42	Conduct placekeeping in procedures	MA		
43	Close out work orders/work requests in work management system	MA		
44	Return equipment to stores	MA		
45a	Plan work packages	MA		
45b	Replan work packages	MA		
46a	Print and assemble work packages	MA		
46b	Process and archive completed work packages	MA		
47	Stock Stores	MA		
48	Prepare quals list	MA		
49	Document work history	MA		
50	Update M&TE database	MA		
51	OJT/TPE	MA		
52	Develop fleet/industry aligned programs	MA, SY		
53	Manage/document program work (PM, lifting/rigging, Security programs, etc)	MA, SY		
54	Sign off on program work	MA, SY		
55	Scope work for work week	WM		
56	Develop Online Work Schedules	WM		
57	Perform resource levelization	WM		
58	Close out Work Orders	WM		
59	Monitor work progress/execution	WM		
60	Perform Outage Critique	WM		
61	Perform Post Work Week Critique	WM		
62	Coordinate emergent activity requests	WM		
63	Prepare Outage Readiness/Scope Outage	WM		

	Common Tasks	Functional Area	% Units Saved	% Time Saved
64	Develop Outage Schedules	WM		
65	Manage risk management plans	WM		
66	Conduct safety shutdown assessments	WM		
67	Minimize emergent work risk	WM		
68	RP dose monitoring/ dose measurements, samples etc.	RP		
69	RP contamination monitor alarm response	RP		
70	Maintain dose records	RP		
71	Maintain records of job coverage	RP		
72	Issue TLDs	RP		
73	Issue electronic dosimeter	RP		
74	Routine surveys/surveillances	RP		
75	Issue equipment	RP		
76	Maintain respiratory protection	RP		
77	Maintain equipment	RP		
78	Handle/package radwaste	RP		
79	Ship/receive radwaste	RP		
80	Issue documentation	RP		
81	Report ALARA activities	RP		
82	Plan ALARA activities/write RWP	RP		
83	Install/remove shielding	RP		
84	Plan RP Work Order Tasks	RP		
85	Chemistry samples and analysis	CY		
86	Monitor effluent/environmental stations	CY		
87	Maintain permits	CY		
88	Collection and monitoring of system performance metrics	CY		
89	Data evaluation and trending of system	CY		
90	Maintain instrumentation	CY		
91	Monitor environment	CY		
92	Design Modifications/Change Requests	EN		
93	Oversee contractor modifications/calculations	EN		
94	Update drawings	EN		
95	Develop health reports	EN		
96	Trend data	EN		
97	Evaluate data	EN		
98	Review operating experience	EN		
99	Participate in troubleshooting activities	EN		
100	Walk down systems	EN		
101	Resolve WO/WRs On Hold	EN		
102	Participate in Operability Determinations	EN		
103	Perform Probabilistic Risk Analysis	EN		
104	Conduct NDE/ISI/RT/UT Exams	EN		
105	Maintain simulator	TR		
106	Manage training database	TR		
107	Manage accreditation programs/reports	TR		
108	Analyze training needs	TR		
109	Design classes	TR		
110	Instruct classes	TR		
111	Evaluate trainees (develop/supervise exams)	TR		
112	Manage regulatory relationships	TR		
113	Maintain learning technology	TR		
114	Track and Report on performance indicators	PI		
115	Support internal initiatives (site projects, etc)	PI		
116	Participate in external initiatives (industry benchmarking, assessments, etc)	PI		
117	Track and Report on Safety	PI		
118	Conduct rounds	SY		
119	Stand watch	SY		
120	Issue site/contractor badges	SY		
121	Conduct random drug tests	SY		
122	Create procedure/program documents	PR		
123	Review procedures/program documents	PR		
124	Issue procedure/program documents	PR		
125	Manage/administer investigation (e.g. PI)	CA		
126a	Processing Condition Reports	CA		
126b	Conduct Corrective Actions for Condition Reports	CA		
127	Apparent Cause Evaluations	CA		
128	Root Cause Evaluations	CA		
129	Employee Investigations	CA		
130	Conduct trending analysis	CA		

	Common Tasks	Functional Area	% Units Saved	% Time Saved
131	Screen condition records	CA		
132	Perform decontamination work	MA, RP		
133	Calibrate equipment	MA, RP		
134	Establish vendor contracts	MA, TR		
135a	Conduct inspections/rounds	OP, CY		
135b	Conduct surveillances and tests	OP, CY		
136	Sign off work orders/procedures	OP, MA		
137	Provide input to work schedule (resources, quals, feedback, etc.)	OP, MA		
138	Support emergent activity requests	OP, MA		
139	Obtain Pre-Job Brief	OP, MA, CY, RP		
140a	Assign work to crews	OP, MA, CY, RP		
140b	Verify Qualifications	OP, MA, CY, RP		
141	Conduct Pre-Job Brief	OP, MA, RP		
142	Participate in training	OP, MA, WM, RP, CY, EN, TR		
143	Provide training	RP, CY		
144	Perform calculations	RP, EN		
145	Install/remove temp mods (instrumentation, jumpers) for testing/maintenance	OP, MA		
146	Emergent parts delivery	WM		
147	Personnel safety monitoring (confined space, air quality monitoring)	RP		
148	Security compensatory actions (breached security barriers)	SY		
149	Fire watches	OP, SY		
150	Buried pipe location	EN		
151	Refuel mobile equipment (generators, grading equipment, etc.)	MA		
152	Maintain equipment database	EN		

Non-Labor Cost - Online

Functional Area	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
Operations	Contract Services	Uniform Services			$ -	
	Material & Tools	MGT Uniforms			$ -	
	Material & Tools	Fire Protection tools/supplies			$ -	
	Material & Tools	New Oil Products/Greases			$ -	
	Material & Tools	Other consumables			$ -	
	Material & Tools	Diesel Fuel			$ -	
	Material & Tools	Labeling Material			$ -	
	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Maintenance	Contract Services	Janitorial Services			$ -	
	Contract Services	Facility Repairs Contract			$ -	
	Contract Services	Facility Repairs			$ -	
	Contract Services	Trash			$ -	
	Contract Services	Pest Control			$ -	
	Contract Services	Lawn care			$ -	
	Contract Services	Snow removal			$ -	
	Contract Services	Maintenance Mod Contractor			$ -	
	Contract Services	Walk downs & Estimates			$ -	
	Contract Services	Equipment Rental			$ -	
	Contract Services	Vehicles (Leased or Owned)			$ -	
	Contract Services	Diving			$ -	
	Contract Services	Outside Tech Rep/Vendor			$ -	
	Contract Services	CRD Rebuilds			$ -	
	Contract Services	SRV Rebuilds			$ -	
	Contract Services	Pump Overhaul			$ -	
	Contract Services	Valve Rebuilds			$ -	
	Contract Services	Equipment & Tool Repairs			$ -	
	Contract Services	Breaker Overhauls			$ -	
	Contract Services	Outside Tech Rep/Vendor Support			$ -	
	Contract Services	Offsite Motor Repairs			$ -	
	Contract Services	Elevator Inspection & Repair			$ -	
	Contract Services	Oil Analysis			$ -	
	Contract Services	Oil/Diesel Fuel Analysis			$ -	
	Contract Services	Package prep			$ -	
	Material & Tools	Fire retardant uniforms			$ -	
	Material & Tools	Material Delivery			$ -	
	Material & Tools	Open & Working Stock			$ -	
	Material & Tools	Janitor/housekeeping			$ -	
	Material & Tools	Paint supplies			$ -	
	Material & Tools	Vehicle Fuel			$ -	
	Material & Tools	Facility maintenance			$ -	
	Material & Tools	Non-Capital Tools			$ -	
	Material & Tools	Material			$ -	
	Material & Tools	Package prep (paper)			$ 160,000	80% 20,000 packages @ 100 pages @ $.10 per sheet

Non-Labor Cost - Online

Functional Area	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Project Management	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Work Management	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Radiation Protection	Contract Services	Lab Services			$ -	
	Contract Services	Sample Analysis			$ -	
	Contract Services	Laundry			$ -	
	Contract Services	Dosimetry/TLD			$ -	
	Contract Services	Instrument Repair/Calibrations			$ -	
	Contract Services	Remote Monitoring			$ -	
	Contract Services	Decon			$ -	
	Material & Tools	Telemetry Sleds			$ -	
	Material & Tools	Respiratory Equipment			$ -	
	Material & Tools	Protective Clothing			$ -	
	Material & Tools	Electronic Dosimeters			$ -	
	Material & Tools	Scrubs			$ -	
	Material & Tools	Decon Supplies			$ -	
	Material & Tools	Disposable Modesty Garments			$ -	
	Material & Tools	Decon Supplies			$ -	
	Material & Tools	Instrumental Supplies			$ -	
	Material & Tools	ALARA Supplies			$ -	
	Material & Tools	Instrumental Supplies			$ -	
	Material & Tools	Other Supplies			$ -	
	Material & Tools	Safety Supplies			$ -	
	Material & Tools	Safety Glasses			$ -	
	Material & Tools	Safety Shoes			$ -	
	Reg Fees & Insurance	Fees, Inc / Contri			$ -	
	Travel	Meeting Expenses			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Chemistry & Environmental	Chemicals	Primary Chemicals			$ -	
	Chemicals	Secondary Chemicals			$ -	
	Contract Services	Radwaste disposal			$ -	
	Contract Services	Nobel Metals			$ -	
	Contract Services	Nobel Metals Coupons			$ -	
	Contract Services	Service/circ water skids/contract			$ -	
	Contract Services	Hazardous Waste Disposal			$ -	
	Contract Services	Sanitary Waste Disposal			$ -	
	Contract Services	Perform chemical analysis/samples			$ -	
	Contract Services	Environmental Studies/Monitoring			$ -	
	Contract Services	MUDs			$ -	
	Contract Services	Tritium			$ -	

Non-Labor Cost - Online

Functional Area	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
	Contract Services	Counting System Maintenance			$ -	
	Contract Services	MET			$ -	
	Contract Services	REMP			$ -	
	Contract Services	Radwaste Supplies			$ -	
	Contract Services	Compressed Gases			$ -	
	Contract Services	NALCO Seconday Chem			$ -	
	Contract Services	Equipment Rental			$ -	
	Material & Tools	Lab equipment mtc & consumables			$ -	
	Material & Tools	Lab Supplies			$ -	
	Material & Tools	Zinc			$ -	
	Material & Tools	Resins			$ -	
	Material & Tools	Condensate Polisher Filters			$ -	
	Material & Tools	Mt`ls for mixed, hazardous waste			$ -	
	Material & Tools	Bulk Gases			$ -	
	Material & Tools	Compressed Gases			$ -	
	Reg Fees & Insurance	Environmental permit fees			$ -	
	Travel	Meeting Expenses			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Engineering	Contract Services	NSSS / Turbine Rep			$ -	
	Contract Services	NSSS Representative			$ -	
	Contract Services	Emergent Tech Support			$ -	
	Contract Services	Failure Analysis			$ -	
	Contract Services	NDE			$ -	
	Contract Services	ANI Svcs. On			$ -	
	Contract Services	Eddy Current Testing			$ -	
	Contract Services	ISI Program Support			$ -	
	Contract Services	Misc Tests/Studies			$ -	
	Contract Services	Motor			$ -	
	Contract Services	Cathodic Protection			$ -	
	Contract Services	PRA			$ -	
	Contract Services	Technical Eval/ Speciality Eng Support			$ -	
	Contract Services	Vendor Manual Update program			$ -	
	Contract Services	VETIP			$ -	
	Contract Services	EQ Binder Updates			$ -	
	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Security	Material & Tools	Range Supplies			$ -	
	Material & Tools	Uniform Services			$ -	
	Material & Tools	Uniforms			$ -	
	Material & Tools	Ammunition			$ -	
	Material & Tools	Radio Batteries			$ -	
	Material & Tools	Misc. Consumables			$ -	
	Contract Services	Equipment Maintenance & Repairs			$ -	
	Contract Services	Permits/Licenses and Memberships			$ -	
	Contract Services	Range Fees			$ -	

Non-Labor Cost - Online						
Functional Area	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
	Contract Services	Range Maintenance			$ -	
	Contract Services	Guard Services			$ -	
	Travel	Meeting Exp			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Records Management	Material & Tools	Microfilm Supplies			$ -	
	Material & Tools	Microfilm Processing			$ -	
	Material & Tools	Postage and Delivery			$ -	
	Contract Services	Printer/Copier/Fich Repairs			$ -	
	Contract Services	Record Storage Costs			$ -	
	Travel	Meeting Expense			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Health Services	Contract Services	Nurse Services			$ -	
	Material & Tools	Nurse Materials			$ -	
	Travel	Meeting Expense			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Licensing, Reg Affairs, PI, EP	Reg Fees & Insurance	NRC Fixed Fee			$ -	
	Reg Fees & Insurance	FEMA Fee			$ -	
	Reg Fees & Insurance	NRC Operator Exams			$ -	
	Reg Fees & Insurance	NRC Inspections			$ -	
	Reg Fees & Insurance	NRC - Part 50			$ -	
	Reg Fees & Insurance	Nuclear Safety Review Board			$ -	
	Reg Fees & Insurance	NEIL Insurance			$ -	
	Travel	Meeting Expense			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Training	Contract Services	Specialty Training			$ -	
	Contract Services	License Exam Prep			$ -	
	Material & Tools	Training Mockup consumables			$ -	
	Material & Tools	Lab Supplies			$ -	
	Travel	Meeting Expense			$ -	
	Travel	Business Travel			$ -	
	Travel	Reimbursed and Employee Recognition Expenses			$ -	
Total Non-Labor Cost Savings					**$ 160,000.00**	

Non-Labor Cost - Outage

Summary Cost Category	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
MMC	Contractor Services	Condenser Inspec and Repair			$ -	
		Cooling Tower Inspec and Repair			$ -	
		Decon Support			$ -	
		De-mobilization			$ -	
		Dry Well Support			$ -	
		Dry Well/Containment Support			$ -	
		Electrical Inspec and Repair			$ -	
		FAC/ISI Support			$ -	
		Feedwater Heater Inspec and Repair			$ -	
		Heat Exchanger and Coolers Inspec and Repair			$ -	
		In- Processing			$ -	
		Indirect Craft Support			$ -	
		Insulation Support			$ -	
		Luse Insulation			$ -	
		Mechanical Inspec and Repair			$ -	
		Mobilization			$ -	
		Non-Manual Non-Distributable Support			$ -	
		Non-Manual Support			$ -	
		Nurse Support			$ -	
		Other			$ -	
		Painting & Hydrolazing Support			$ -	
		Reactor Support			$ -	
		ROV and Camera Support			$ -	
		Scaffolding			$ -	
		Seconded Labor			$ -	
		Snubber Inspec and Repair			$ -	
		Steam Generator Support			$ -	
		Suppression Pool / Torus Support			$ -	
		Temporary Power and Lighting			$ -	
		Temporary Shielding			$ -	
		Tool Room Support			$ -	
		Turbine Support			$ -	
		Valve Inspec and Repair			$ -	
Turbine	Contractor Services	Emergent Work			$ -	
		Exciter			$ -	
		Front Standard			$ -	
		Generator			$ -	
		Grit Blasting			$ -	
		HP Turbine			$ -	
		LP Turbine			$ -	
		Management Team			$ -	
		MDT /RFPT / Feedpump			$ -	
		Mid Standard			$ -	
		Misc. Vendor Support			$ -	

Non-Labor Cost - Outage						
Summary Cost Category	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
		Off Site Machining			$ -	
		OSE to capital valves			$ -	
		Other			$ -	
		Outage Services			$ -	
		POPI			$ -	
		Production Performance			$ -	
		Reliability Program			$ -	
		Turbine Auxiliaries Team			$ -	
		Turbine Incentive			$ -	
		Turbine Mgmt Team			$ -	
		Turbine Service Shop			$ -	
		Turbine Valve Work			$ -	
		Turbine Valve Work to Capital			$ -	
		Turning Gear			$ -	
		W-PWR Contract Fixed			$ -	
Reactor	Contractor Services	IOC Disassembly			$ -	
		Outage Services			$ -	
		Fabrication			$ -	
		Fuel Handling Equipment Support (PaR)			$ -	
		Head Tensioner Support (Biach)			$ -	
		IOC Disassembly			$ -	
		IOC Fuel shuffles			$ -	
		IOC HCU			$ -	
		IOC Incentive			$ -	
		IOC Reassembly			$ -	
		IOC Refuel Floor to Capital			$ -	
		Other			$ -	
		Par Truck			$ -	
		Robotics (ROV)			$ -	
ISI	Contractor Services	Inspection Service Tooling			$ -	
		Equipment Rental			$ -	
		Consumables			$ -	
		Boric Acid VT			$ -	
		VT Pressurizer Heaters			$ -	
		FAC-UT			$ -	
		ISI XI Manual NDE Exams			$ -	
		Snubber Support			$ -	
		IOC IVVI			$ -	
		Eddy Current Heat Exchange			$ -	
		Eddy Current Main Condenser			$ -	
		FAC-Radiography			$ -	
		IOC Auto Piping			$ -	
		IOC FAC-UT			$ -	
		IOC Incentive			$ -	

Non-Labor Cost - Outage						
Summary Cost Category	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
Steam Generator	Contractor Services	Project Team			$ -	
		Primary Services			$ -	
		Management Team			$ -	
		Secondary Services			$ -	
Other Services	Contractor Services	ANI Support			$ -	
		Blanket Insulation			$ -	
		Bus Duct Inspections			$ -	
		Cavity Decon			$ -	
		Decon			$ -	
		Diesel Technical Support			$ -	
		Disposable Modesty Garments			$ -	
		Diving			$ -	
		Generator Ring Grinding			$ -	
		Hatch Oversight			$ -	
		Hydrolazing Services			$ -	
		Janitorial - Non-RPA			$ -	
		Janitorial - RPA			$ -	
		Laundry			$ -	
		Mirror Insulation			$ -	
		MOV Technical Support			$ -	
		MSSV Repairs			$ -	
		Oil Analysis			$ -	
		Overhead Crane Support			$ -	
		Pump Technical Support			$ -	
		Rod Control Maintenance			$ -	
		RP Support			$ -	
		Trevitest			$ -	
		Valve Technical Support			$ -	
On-Site Labor	Base Labor	Department #1			$ -	
		Department #2			$ -	
		Department #3			$ -	
		Department #4			$ -	
		Department #5			$ -	
Overtime	Base Labor	Department #1			$ -	
		Department #2			$ -	
		Department #3			$ -	
		Department #4			$ -	
		Department #5			$ -	
Off-Site Labor	Base Labor	Department #1			$ -	
		Department #2			$ -	
		Department #3			$ -	
		Department #4			$ -	
		Department #5			$ -	
Materials	Material & Tools	Fire Protection tools/supplies			$ -	

Non-Labor Cost - Outage

Summary Cost Category	Sub-Account	Detailed Cost Category	Cost Before	Cost After	Estimated Savings ($)	Comments / Qualitative Benefits
		ALARA Supplies			$ -	
		Bulk Gases			$ -	
		Compressed Gases			$ -	
		Condensate Polisher Filters			$ -	
		Decon Supplies			$ -	
		Decon Supplies			$ -	
		Disposable Modesty Garments			$ -	
		Electronic Dosimeters			$ -	
		Instrumental Supplies			$ -	
		Lab equipment mtc & consumables			$ -	
		Lab Supplies			$ -	
		Mt`ls for mixed, hazardous waste			$ -	
		Other Supplies			$ -	
		Protective Clothing			$ -	
		Resins			$ -	
		Respiratory Equipment			$ -	
		Safety Glasses			$ -	
		Safety Shoes			$ -	
		Safety Supplies			$ -	
		Scrubs			$ -	
		Telemetry Sleds			$ -	
		Training Mockup consumables			$ -	
		Zinc			$ -	
		Diesel Fuel			$ -	
		Facility maintenance			$ -	
		Janitor/housekeeping			$ -	
		Labeling Material			$ -	
		Material			$ -	
		Material Delivery			$ -	
		Misc. Consumables			$ -	
		New Oil Products/Greases			$ -	
		Non-Capital Tools			$ -	
		Nurse Materials			$ -	
		Open & Working Stock			$ -	
		Other consumables			$ -	
		Package prep (paper)			$ 18,600.00	30% of 3,100 packages @ 200 pages @ $.10 per page
		Paint supplies			$ -	
		Postage and Delivery			$ -	
		Radio Batteries			$ -	
		Vehicle Fuel			$ -	
					$ -	
Total Non-Labor Cost Savings					**$ 18,600.00**	

Key Performance Indicators

#	Level 1 Level 2 Sub-Indicator	Metric measured by	Measured by (Unit/Plant)	Top Quartile/ Maximum Value		Current Value	Potential Value	Comments / Qualitative Benefits
1	INPO Index	#	Unit	98/100	T.Q/Max			
2	Net Generation (TWh)	#						
3	Total Industrial Safety Accident Rate (TISAR)	Rate	Plant	0.02	T.Q			
4	Collective Radiation Exposure (CRE)	#	Unit	96.9 BWR 30.4 PWR	T.Q			
5	Unit Capacity Factor - Refuel Cycle	%	Unit	93%	T.Q			
6	Unit Forced Loss Rate - Refuel Cycle	%	Unit	0.40%	T.Q			
7	Unit Capability Factor - Refuel Cycle	%	Unit	93.80%	T.Q			
8	Unplanned Weighted Manual and Automatic Scrams	#	Unit	0	T.Q			
9	Total Production Cost (O&M, Capital, and Fuel)	$	Plant					
Level 2								
10	Equipment Reliability Index	#	Unit	93/100	T.Q./Max			
11	Reportable Environmental Events	#	Plant	0	T.Q.			
12	Reactivity Management	%	Unit	95.60%	T.Q.			
13	Total Recordable Injury Rate - Rolling 12 months	Rate	Plant	0	T.Q.			
14	Human Performance Event Rate - Rolling 12 months	Rate	Plant	0.002	T.Q.			
15	Operator Burdens	#	Unit	<2	T.Q.			
16	Control Room Deficiencies	#	Unit					
17	Operator Work Arounds	#	Unit	<2	T.Q.			
18	Corrective Critical Backlog	#	Plant	0	T.Q.			
19	Corrective Critical Non-Critical Backlog	#	Plant	<20	T.Q.			
20	Deficient Critical Backlog	#	Plant	<40	T.Q.			
21	Deficient Non-Critical Backlog	#	Plant	<140	T.Q.			
22	Personal Contamination Events (PCEs) - Online	#	Plant	<2	T.Q.			
23	Personal Contamination Events (PCEs) - Outage	#	Plant	<20	T.Q.			
24	Online schedule completion	%	Plant	>93%	T.Q.			
25	Schedule Stability	%	Plant	>93%	T.Q.			
26	Deferred PM Work Orders	#	Plant					
27	PMs Deep in Grace	#	Plant					
28	Critical PMs Deep in Grace	#	Plant					
29	Outage Milestones Missed	#	Unit	0	T.Q.			

INL Business Case Methodology Workbook

Labor Rates (hourly)				
Labor Type	**Built-up Rate**	**Base Rate**	**Fringe**	**OT**
PM/Dir	126	85	28	13
Mgr/Engr	89	60	20	9
Supervisor	89	60	20	9
System Operator	59	40	13	6
Operator	74	50	17	8
WW Mgr	74	50	17	8
Craft Tech Support	74	50	17	8
Craft/Tech	59	40	13	6
Helpr/Train	52	35	12	5
Planner	67	45	15	7
Admin	33	22	7	3

Notes:
Rates presented are illustrative and believed to be typical for industry.
Rate assumes 33% fringe load and 10% OT & 1.5x base rate.
Fixed cost overheads not included in rate.