

Fort Calhoun Station Challenges and Successes During Major Equipment Replacement Activities

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The Big Outage - NSSSRP

- What Made this outage unique
 - Create a opening in containment
 - Replaced the steam generators
 - Replaced the pressurizer
 - Replaced the reactor vessel head
 - Replaced sump strainers
 - Installed a “Rapid Refueling Package”
 - Replaced both low pressure turbines
 - Replaced the hydrogen coolers
 - Replaced the main transformer
 - Oh yah, normal outage activities also

What was at Stake

- Budget of \$417.5 million
- Outage duration goal of 90 days
- Dose goal started out at 396 Rem
- The corporations financial footing
- Success was our only option
- By the way new RPM one-year prior to outage



Second Time Performance the First Time

- Plan
 - Can't benchmark enough
- Prepare
 - Detailed ALARA and work planning packages
- Practice
 - Dry runs, mockup training, practice, practice, practice
- Perform as a Team
 - Work the plan , teambuild and coach/mentor
- Alignment
 - One set of goals in mind

Station Challenges

- Small station/small containment/small Protected Area footprint
- In/out processing over 2000 supplemental workers
- Containment could not hold everything at one time (had to play the three shell game – detailed lay down plan)
- Largest scope outage by a small utility

RP Challenges – Outage Success Factors

- RP “Plan of the Plan”
- RP interface and staffing plan
- Improved and earlier ALARA planning
- Access and egress from RCA
- Radiation worker & mockup training plan
- Comprehensive shielding plan
- Procedure/Guideline review & outage lessons learned

RP Challenges – Outage Success Factors

- Radiological equipment/instrument plan
- Contingency planning
- RP leadership in the field
- Radiography planning
- Radwaste/Decon/Radmaterail handling plan
- Demobilization - decon facility plan

RP Plan of the Plan

- Detailed out all RP work activities required to be successful
- Identified all projected RP work items
- Assigned owners
- Assigned due dates
- Governing plan for the other more detailed plans

RP Interface and Staffing Plan

- Detailed how RP would interface and integrate with the NSSSRP (Bechtel)
- Detailed how RP work group would work on a day-to-day basis
- Defined the RP Organization
 - Both NSSSRP radiation protection
 - Balance of plant radiation protection
- Defined the division of responsibilities
- Staffing was successful with the following numbers

Position	BOP	NSSSRP	Total
Coordinator/Planner	1	2	3
RP Lead	0	3	3
ALARA	2	2	4
SR. RP	23	62	85
Jr. RP	8	8	16
Decon Lead	0	2	2
Decon	20	31	51
Dosimetry	2	2	4
Cert. RW Shippers	1	1	2
Totals	57	113	170

ALARA Planning

- Required benchmarking of other utilities
 - Palo Verde and Beaver Valley for SGRs
 - St. Lucie for pressurizer and reactor vessel head replacement
 - Callaway for demobilization and radioactive material handling
- Improve our ALARA planning process to be more rigorous
- Develop an “ALARA Incentive Program”
- Revision of dose goals to keep station challenged

RCA Access and Egress Planning

- How do we move nearly 2000 radiation workers in and out of containment safely
- Needed a second RCA access control area, with another entrance and exit from the RCA. Included:
 - Containment access facility (CAF) RP control point and dress out area
 - Reconfigure the containment building personnel air lock exit area
 - Second RCA entrance with electronic turnstiles
 - Second exit from the RCA with personnel contamination monitors and small article monitors
 - Predesignated travel path between CAF and containment
 - Construction opening RCA access/egress
 - A detailed facility equipment list

Radiation Worker & Mockup Training

- Large number of inexperienced radiation workers
- Did standup radworker training with radworker practical factors
- 16 detailed mockup training plans, here are few examples
 - Templating/Severing/Machining RCS piping
 - RCS pipe welding
 - RCS pipe end decontamination
 - RCS internal pipe shielding
 - RCS piping radiography
 - General area shielding
 - RCA nozzle cover installation
 - Pipe end decon waste transport dry run
 - Asbestos enclosure construction
 - Installation and use of pressurizer surge line glove bag and ID grinding

Shielding Plan

- Higher source term plant (five consecutive cycles of failed fuel (1998-2003))
- Unprecedented amount of shielding (180,000 lbs for NSSSRP and BOP)
- Dedicated shielding teams for installation and removal
- Mockup training
- Saved over 100 person-rem of dose

Radiological Equipment/Instrument Plan

- Needed to procure a large amount of RP instrumentation for plant use and remote facilities including:
 - PCMs, PM-7s, interactive turnstiles, SAM-11s (which we moved safely)
 - Electronic dosimeters and high noise dosimeters, wireless routers, remote cameras, monitors, survey instrumentation
 - Air samplers, friskers
 - Spectralink phones, radios, telex communications
- Dedicated I&C technicians to respond to instrumentation needs
- Needed twice as many count room technicians to release material from the RCA
- Purchased used PCMs (which proved to be a reliability issue)

Contingency Planning

- Developed contingency plans to deal with potential issues prior to the outage including:
 - Access control terminals become out of service
 - Containment area radiation monitor alarm
 - Unanticipated airborne radioactivity
 - High radiation and/or locked high radiation area violations (we didn't succeed here)
 - Radiography boundary violation
 - Water leakage from old components during removal and transport
 - Loose contamination outside the construction opening

RP Leadership in the Field

- Need to have constant RP eyes in the Field
- Need to use ALARA cops
- Need to be able to address RP issues quickly and consistently
- Need to have an oversight presence so that supplemental personnel know we are watching

Radiography Planning

- Over 300 radiography shots planned (many more done due to fit-up issues with SGs)
- Detailed radiography plan with dedicated RP radiography team and supervisor oversight
- Needed to manage two radiography vendors
 - Emergent issue with closed cooling water piping on the new reactor vessel head
- Proper boundary setup and monitoring
- No dose or dose rate alarms expected

Radwaste/Radmaterial Handling Plan

- Handling and disposition plan
- Processing and free release plans for equipment
- Radioactive waste estimation and tentative shipping schedule
- A temporary decontamination facility was constructed and staffed inside the protected area

Decontamination Plan

- Contamination cleanup thresholds
- Unexpected events made decon a challenge
 - Containment spray event on day 10 and day 12
- Too many personnel contamination events (PCEs)
 - 120 PCEs the first 4 weeks of the outage (1.14 PCEs/1000 RWP-Hrs)
 - Implemented an improvement plan that reduced the rate of contaminations to 0.25 PCEs/1000 RWP-Hrs
 - Ended up with 195 PCEs (including 15 level IIs)
- Radiation worker practices were challenging

Demobilization - Decon Facility Plan

- Lay down areas for sea vans
- Well documented and understood demobilization schedule of equipment
- Built temporary decon facility
 - Dedicated staffing
 - Dedicated RP equipment
 - Timeline based workload

So How Did we Do?

Outage Successes

- Completed outage in 85 days, 1 hour, 1 minute
- Completed outage \$35 M under budget
- Outage dose = 274.2 Rem
- No radiography dose or dose rate alarms and no boundary violations
- Fully staffed the RP resources needed
- No radioactive waste shipping issues
- Fully demobilized all equipment and released back to vendor

Outage Successes

- No NRC findings with ALARA packages
- RP integrated well into NSSSRP team
- Strong use of camera monitoring system
- Outage shield plan and team concept
- Personnel in-processing
- ALARA cop and cool room concept
- Source term reduction
 - Ultrasonic cleaning of fuel
 - Depleted zinc addition
 - Major component replacement
 - Macroporous resin use

What Didn't We Succeed At

- 4 HRA violations by supplemental personnel working in containment
- Too many PCEs
- PCM reliability issues

What would we do Differently

- Set more challenging dose and contamination goals
- Measure ourselves closer to industry best
- Build-in more defense in depth for high radiation areas
- Questions???

2006 Outage Photos



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