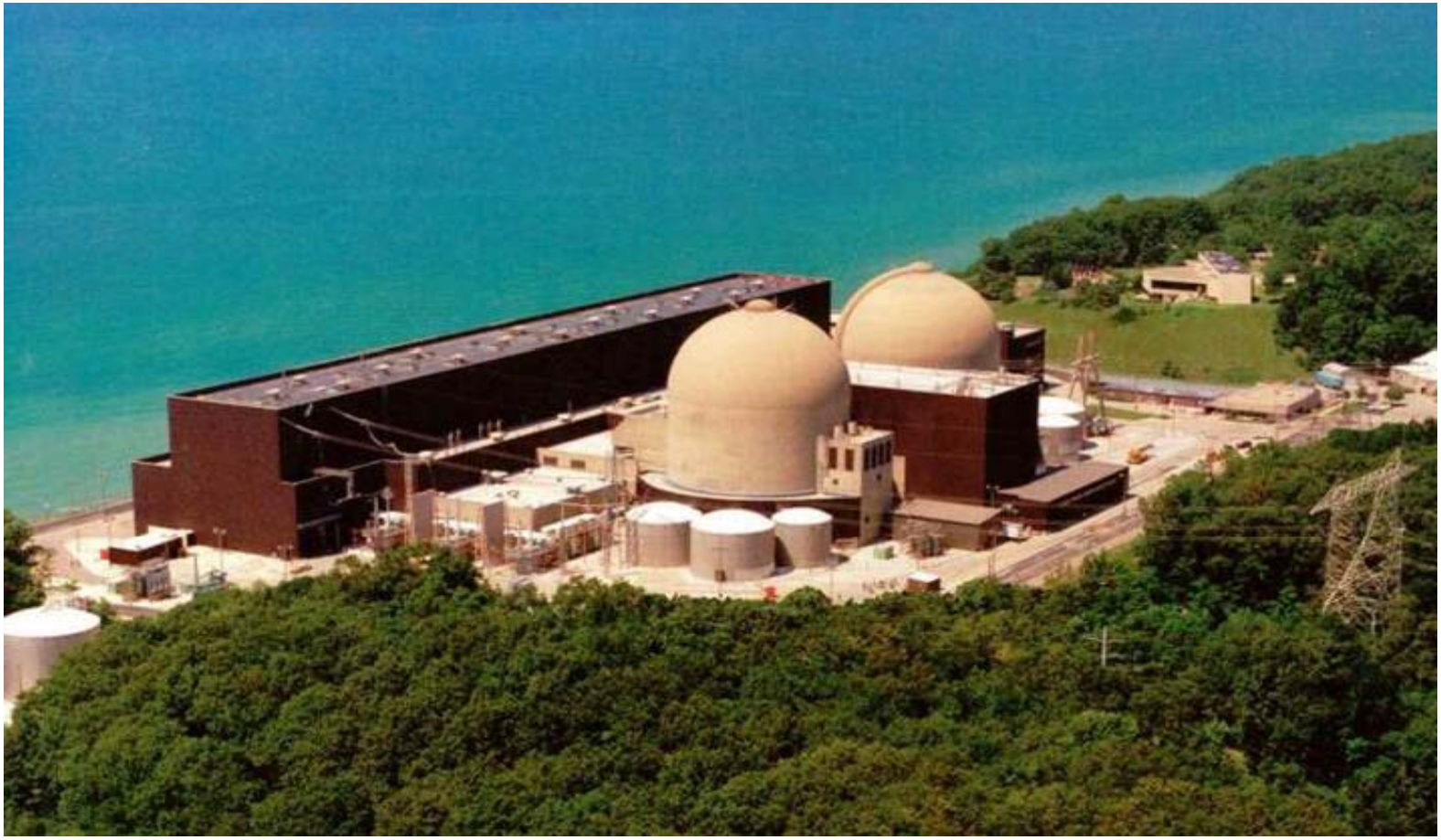


Cook Unit 2 Refueling Outage ALARA Success: 34 Person Rem

Terry Brown, CHP
Director - Radiological Protection, Environmental, Chemistry, and Safety
Cook Nuclear Plant, American Electric Power

2010 ISOE North American ALARA Symposium & EPRI Rad Protection Conference
January 11-13, 2010
Fort Lauderdale, Florida, USA

2009 Performance

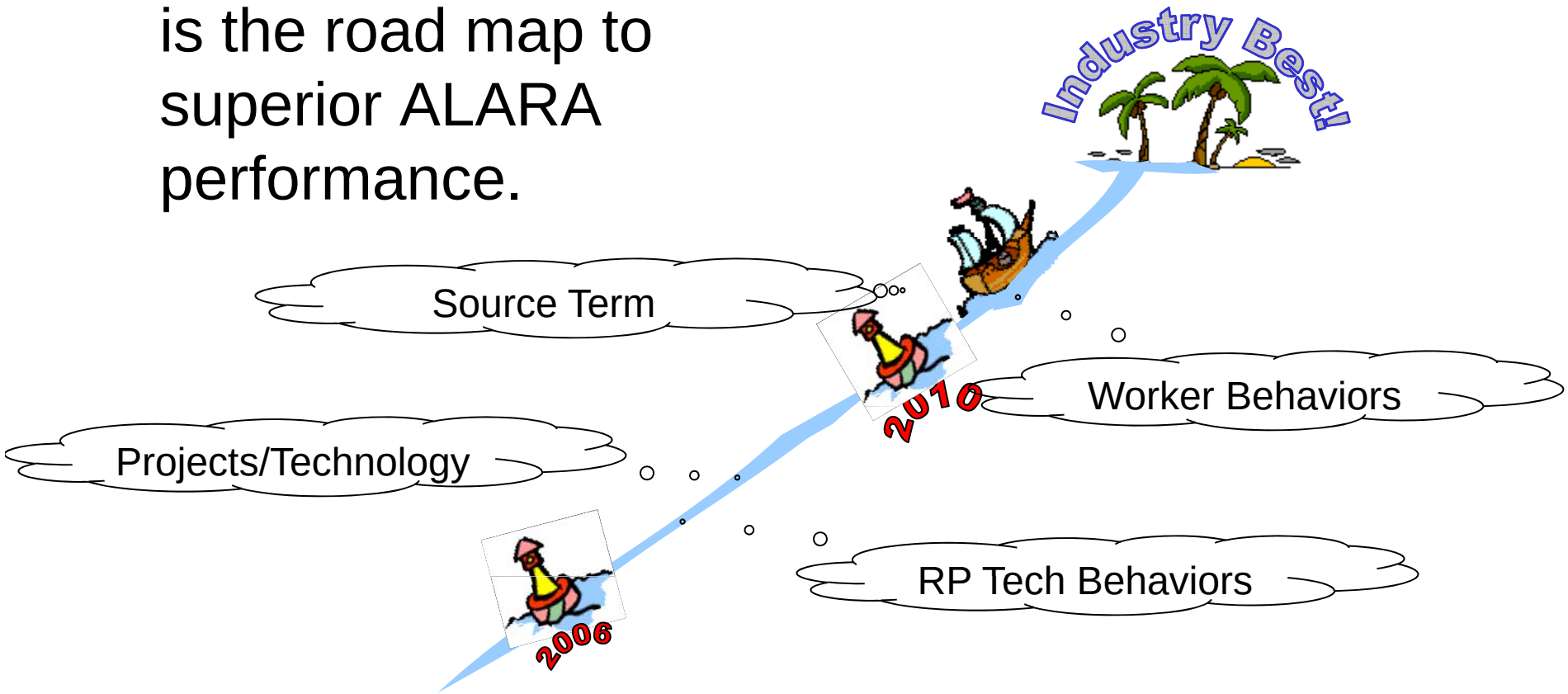
- Unit 2 refueling outage 33.8 person-rem
  - Lowest ever for 4 loop Westinghouse ice condenser.
  - 4th lowest ever for US PWR
  - Excellent chemistry – crud burst 0.855 uCi/g estimated 0.87 uCi/g
  - Lower containment dose rate decrease by 25%
- Unit 1 turbine outage (~15 months) 4.2 person-rem
- On-line 4 person-rem
- Total dose 2 units <42 person-rem

HOW

- Development and execution of 5 year plan
  - Clear benefit, not just dose but eliminating risk
  - Clear owners with due dates
  - Clear cost to allow appropriate forecasting
- Resource commitment
  - Spent ~$25,000,000 on just alara dose reduction initiatives
- Dedication
- Manage distractions

Cook Five Year ALARA Plan

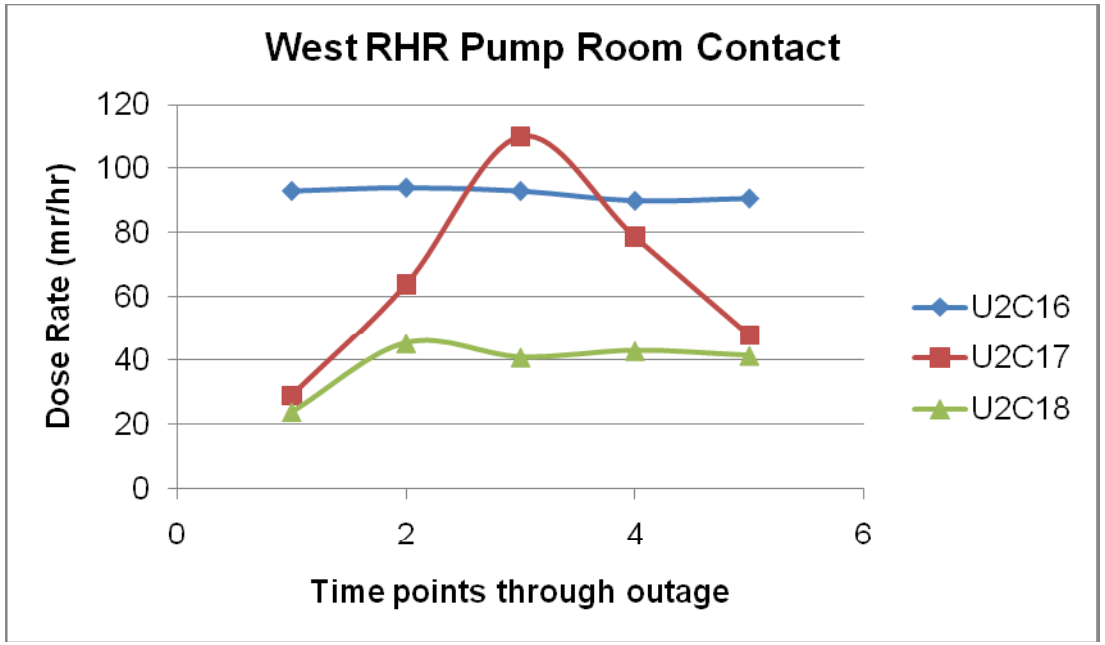
- At Cook, the 5-Year Dose Reduction Plan is the road map to superior ALARA performance.



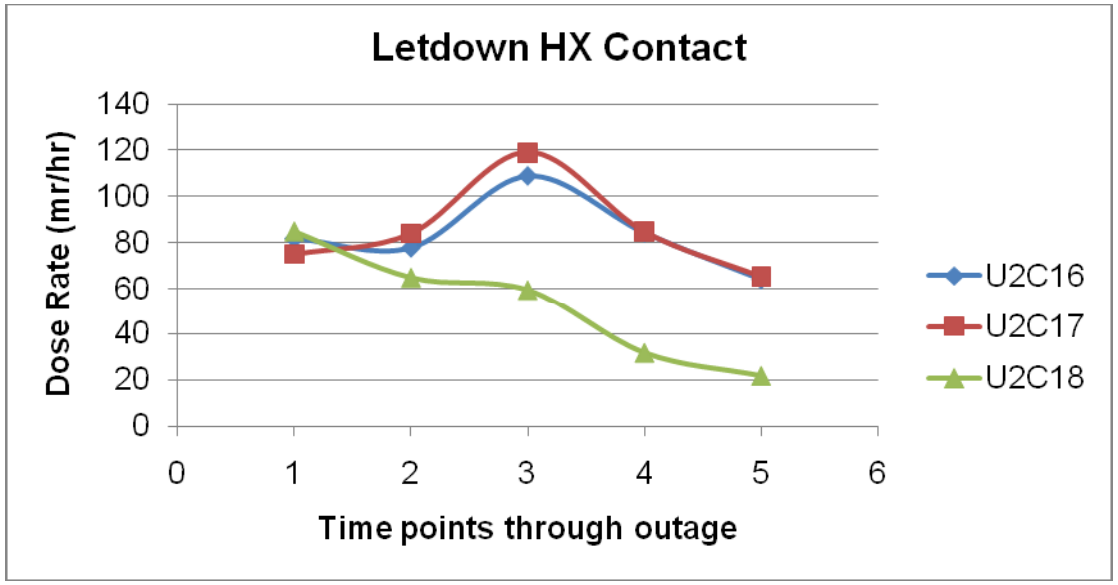
Source Term

- Shutdown and Startup chemistry
- PRC resin (unit 2)
  - Crud burst 2.5 uCi/g to .855 uCi/g
  - Removed 1003 gram Ni during crud burst and 299 grams during start-up
- pH to 7.3
  - This change allows lithium concentrations to be controlled at levels high enough to produce a constant pH throughout the cycle, minimizing early cycle corrosion product deposition on fuel surfaces and subsequent transport out of the reactor core

Dose rates


West RHR Pump Room Contact
Dose Rate (mr/hr)
120
100
80
60
40
20
0
0
2
4
6
Time points through outage
U2C16
U2C17
U2C18

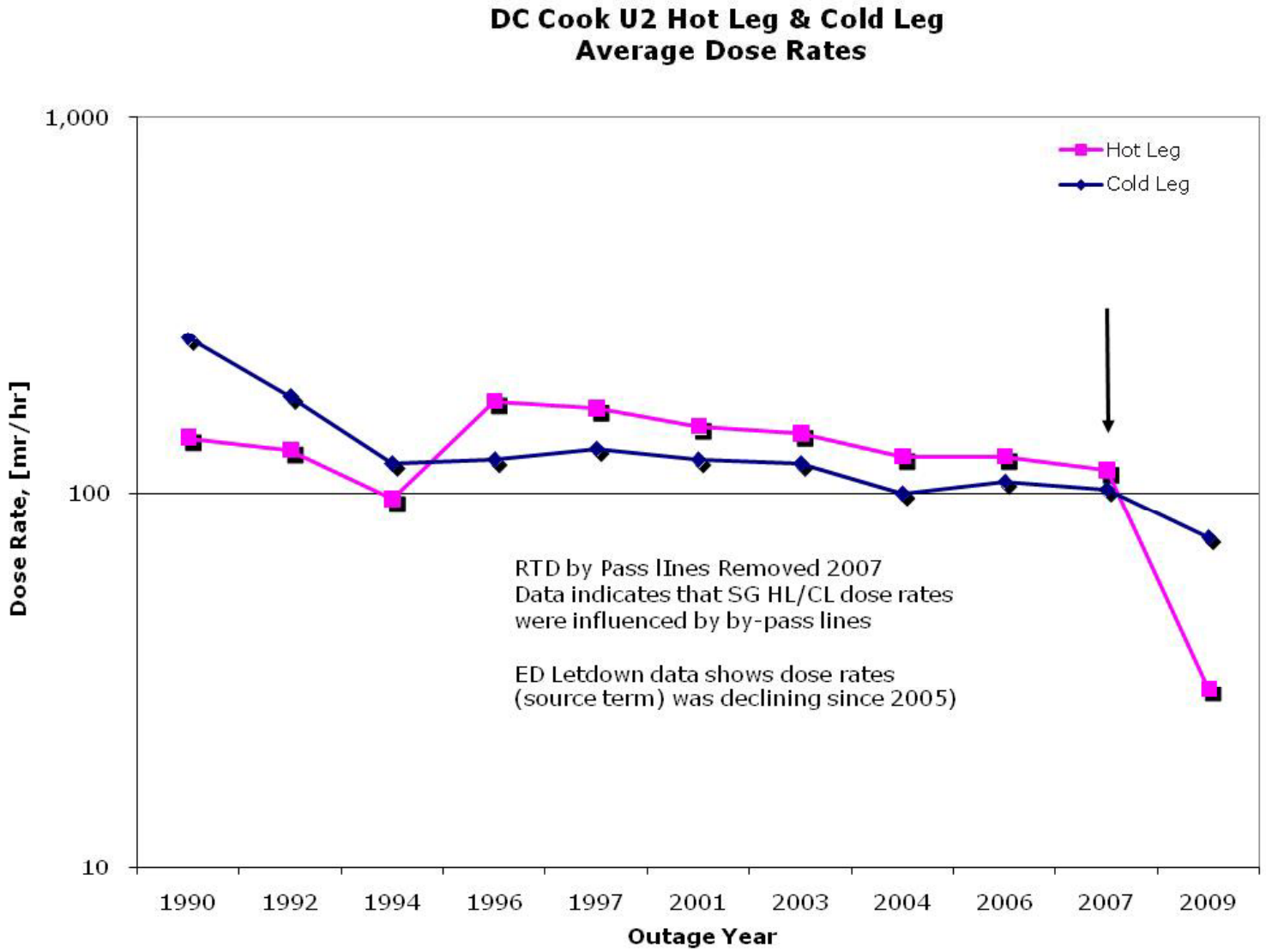
Dose Rates


Letdown HX Contact
Dose Rate (mr/hr)
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
Time points through outage
U2C16
U2C17
U2C18

Projects/technology

- Remove RTD by pass manfolds
- The RDT bypass lines were installed in Westinghouse reactors to provide a coolant temperature SCRAM indicator.
- The lines were small in diameter (~2 inches). Over years of operation, the lines became a “CRUD trap”.
- 25-30% (20-24 person-Rem) Reduction in outage dose has been estimated by the component removal

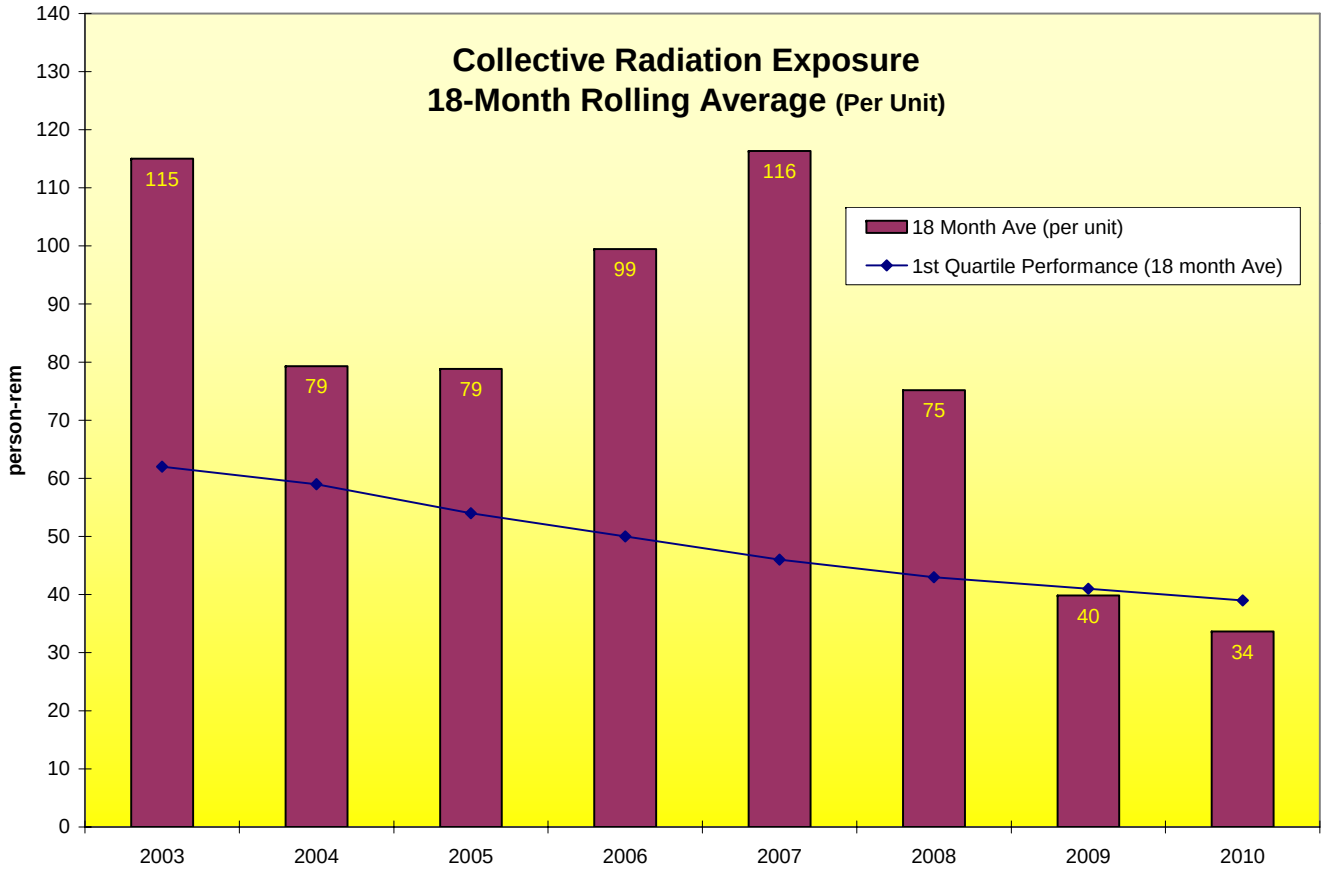
Impact of RTD Bypass Line Removal



Behaviors

- All workers are evaluated in a RP DLA once every three years (won TIP award 2007).
- Specific work groups 1 to 2 years
- All contract RPs evaluated in RP DLA
- Job specific RP training in a job coverage simulator (remote monitoring)
- ALARA Planning - micro alara jobs >10 mrem.

18 month Rolling Average is Projected



Keeping Focus of Execution

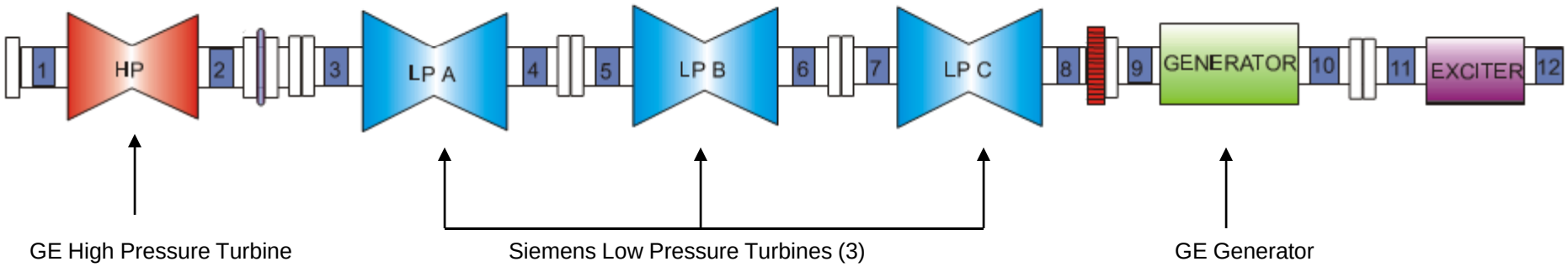
- On Saturday, September 20, 2008 at 2005 hours, the control room experienced simultaneous high-high vibration readings on all main turbine bearings with severe vibration and rumbling felt coming from outside the control room.

- The reactor operator manually tripped the reactor within 5 seconds, all control rods fully inserted, and major systems functioned as designed (Good operator response).

- Turbine generator went from 1800 RPM to 0 RPM in less than 2 minutes.

Event Description

Unit 1 Main Turbine-Generator Overview



Damage Summary

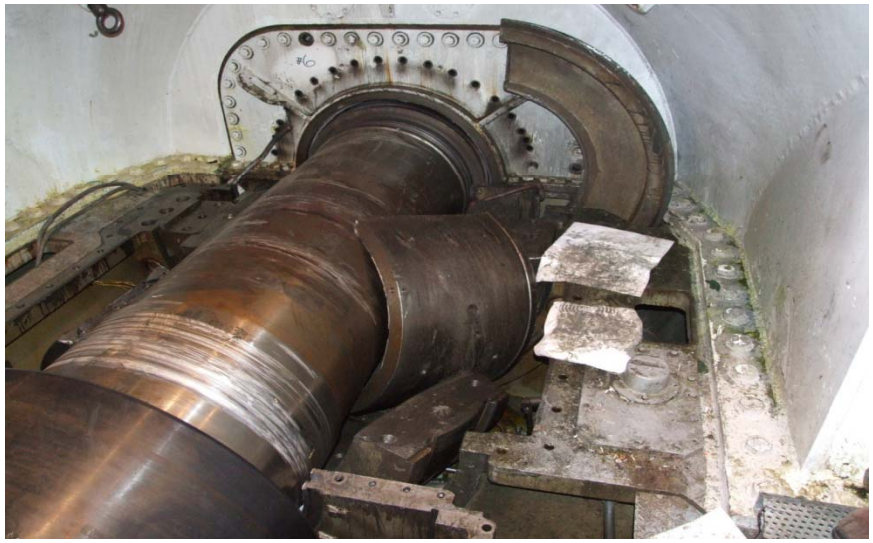
- Fire damage to main generator/exciter housing
- Turbine damage
- Piping insulation damage
- Visible concrete damage around turbine
- Oil spills
- Damaged hangers and supports on various pipe systems

Excellent Response to Event- No Injuries

Damage Summary

- LP turbine exhaust hoods
  - LP turbine exhaust hoods display evidence of blade impact
  - All blades were contained within turbine hoods
  - Bearing housings were displaced

Damage Summary



- Turbine shafts
  - No coast down or turning gear operation
  - Significant shaft scoring
  - Bearing damage evident at all 12 main bearing locations

Initiating Event

- Blade #40 on LP turbine B, turbine side (LP B TS) is liberated due to high cycle fatigue
- Blade #56 on LP B TS also exhibited high cycle fatigue and is liberated during the event
- Blade #189 on LP turbine C TS also exhibited high cycle fatigue and is liberated during the event
- Blades #29 and #64 on LP B TS fracture in overload during the event
- The loss of 5 L-0 blades creates a severe unbalance condition on the rotor

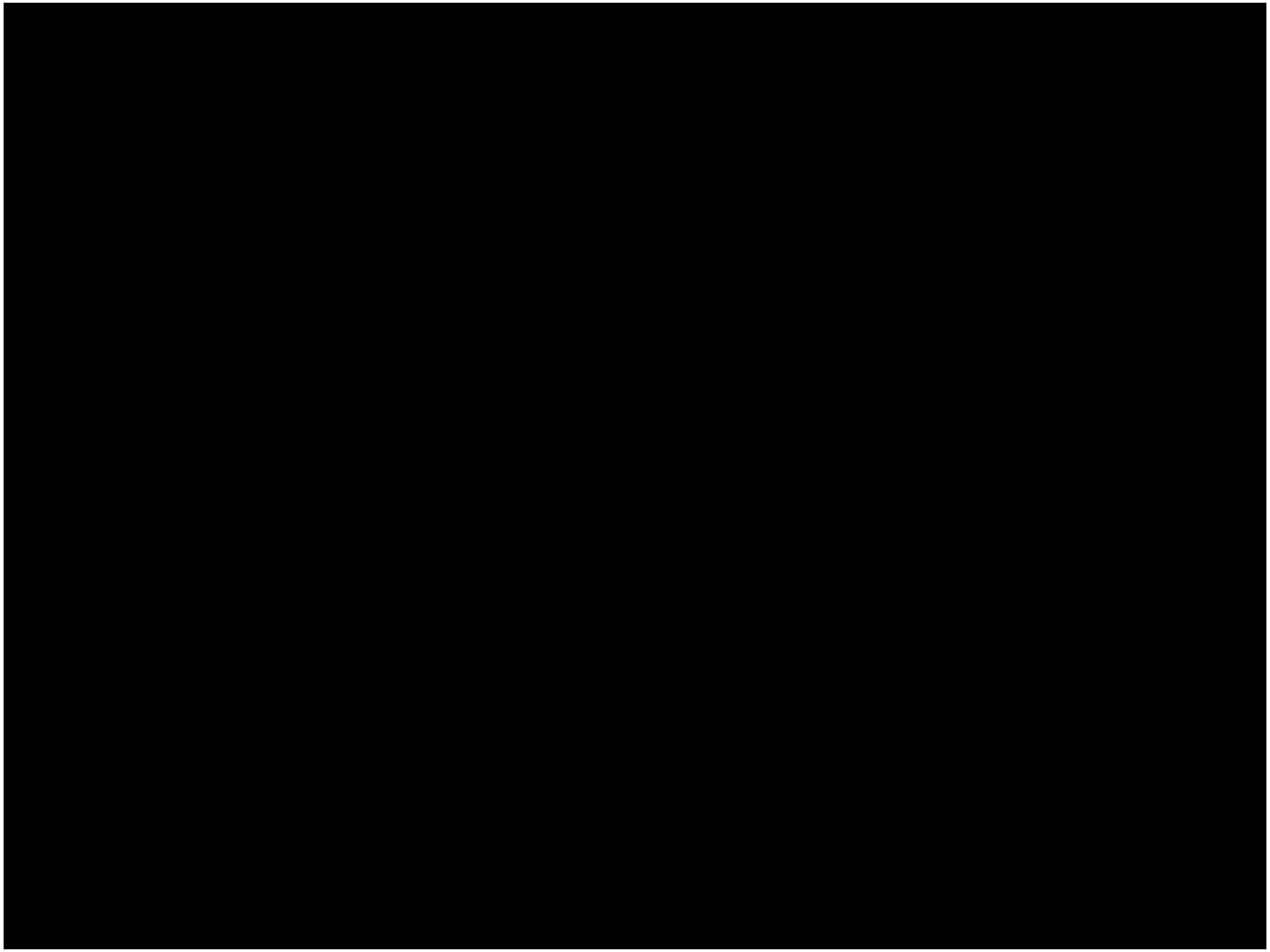
- The high vibration of the unbalanced turbine causes extensive damage to connected systems.

Magnitude of Event

- 59,500 pounds (210 miles) of weld rod
- 43,000,000 pounds safely lifted
- 18,720 rotating blades replaced
- 17,140 stationary blades replaced
- 80,000 pounds of material removed from LP rotors
- 14,800 tasks were completed
- 27,700 ft^3 of asbestos removed (71 basketball courts 1” thick)
- 12,561 air samples taken
- 8,000 ft2 of lead paint removed

Magnitude of Event

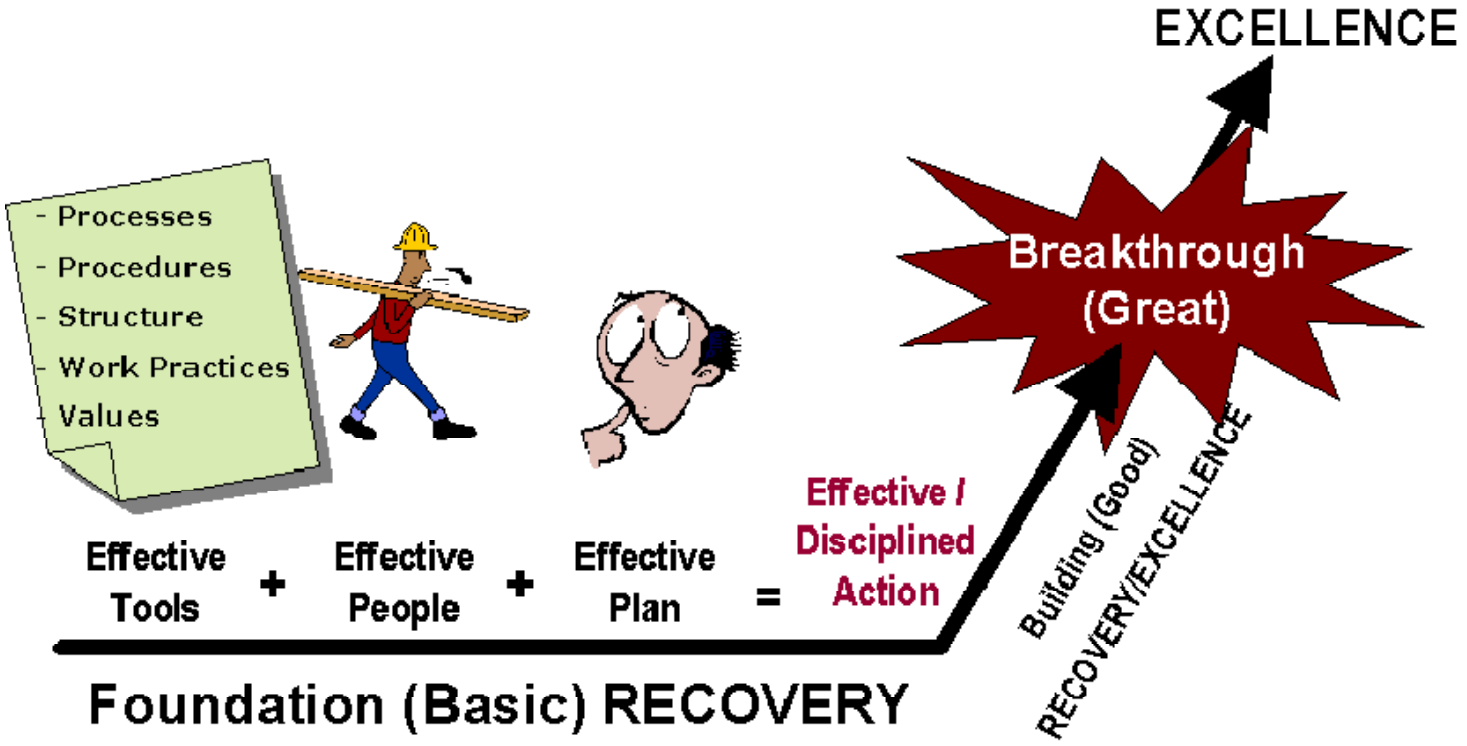
- 48,571 (~108/day) work observations performed
- 486 cables replaced and 58,000 feet of temp cable used
- >3,000,000 person-hrs worked No lost time or restricted
- 5,500 Linear feet of pipe was removed and replaced
- 85,000 parts tracked
- Erected enough scaffolding to build a road 10’ high by 10’ wide for 4 miles
- 960 engineering requests generated
- 23 motors removed and shipped for repair and installed
- 12 bearings rebuilt/replaced



How to keep focus

- Keep ALARA committee a priority
- Separate event
- Keep your key people
- Make key imitative part of incentive plan
- Don’t let momentum stop
- Make sure what you ask for is priority

QUESTIONS?


EXCELLENCE
- Processes
- Procedures
- Structure
- Work Practices
- Values
Breakthrough (Great)
Effective Tools
+
Effective People
+
Effective Plan
=
Effective / Disciplined Action
Building (Good) RECOVERY/EXCELLENCE
Foundation (Basic) RECOVERY