

# Managing quality during reactor outages

Presentation to Nuclear SIG

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## What is an outage?

- A nuclear reactor in an unusual state
  - Reactor pressure vessel partly dismantled (open to atmosphere)
  - Much of the support systems partly dismantled
- A period of intense activity
  - 1600 tasks per week (~600 in an "at power" week)
  - Circa 1000 additional contract staff
- Expensive
  - Approx £1m per day lost revenue + costs

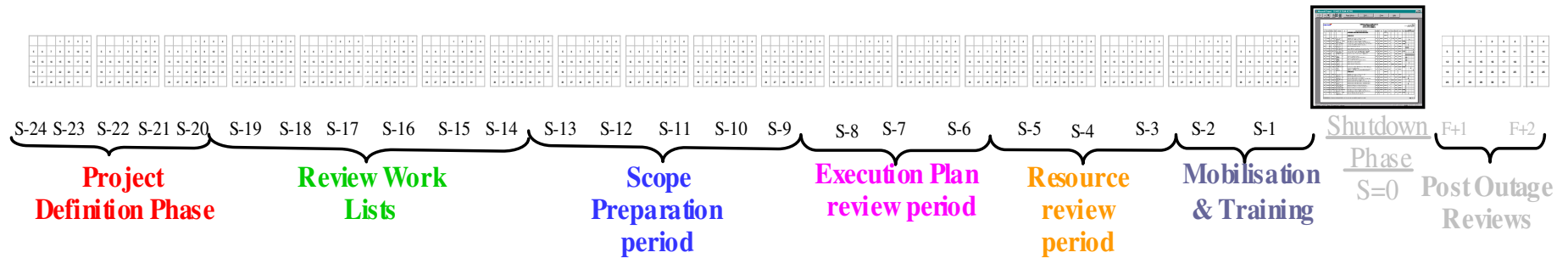


# How do we approach the management of quality?

- There are only three things that matter for outages;
  - Preparation
  - Preparation
  - Preparation

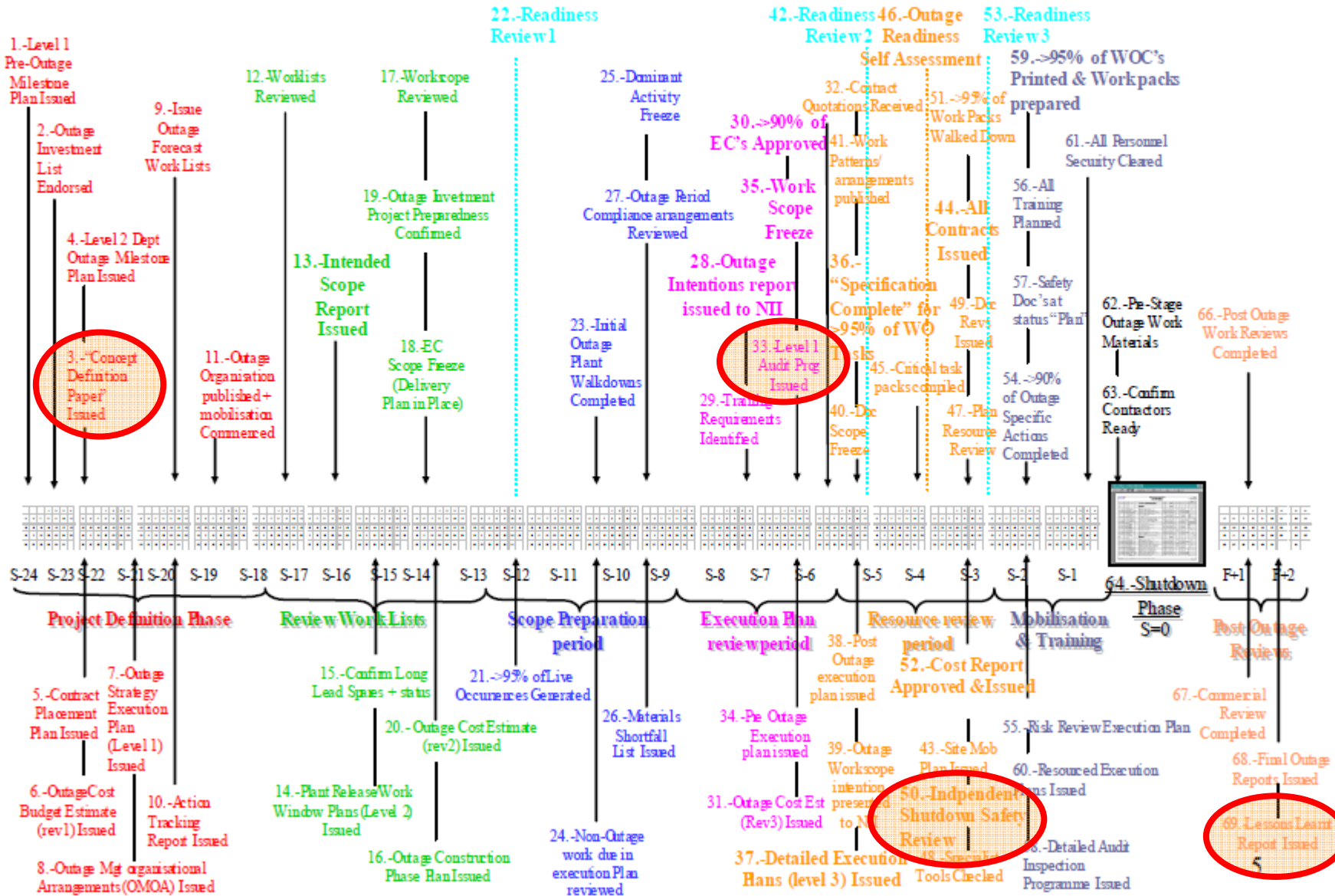


# THE SIX PHASES OF THE OUTAGE PREPARATION PROCESS



# APPENDIX A THE OUTAGE PLANNING PROCESS TIMELINE

S=Months before shutdown



# Shutdown Safety

- In Outage the shutdown plant has to be depressurised and taken to an air atmosphere
- Inspection and repair work means that we then have to open the reactor pressure vessel
- One of our barriers to radioactive release is therefore removed.
- Shutdown safety is term to describe the safety provisions and functions necessary to protect the core in this changed state
- WANO define the key safety functions as decay heat removal, reactor coolant inventory control, electrical power availability, reactivity control, and containment.
- For AGRs they are reactivity control, primary circuit decay heat removal, secondary circuit decay heat removal, electrical power availability and vessel repressurisation.



# Defence in Depth

- We maintain multiple barriers to events wherever possible. This concept is known as Defence in Depth
- For shutdown reactors we produce “defence in depth plans” which show that sufficient barriers to release exist at all times.
- These defence in depth plans are reviewed pre outage in an Independent Shutdown Safety Review (ISSR) 3 months before the outage start
- The ISSR also reviews the outage plan for “high risk evolutions” which require additional compensatory measures



# Quality arrangements

- The audit programme includes inspections and audits for
  - Nuclear Safety
  - Industrial Safety
  - Quality Assurance
- Standards and processes are specified in the programme
- Tasks selected for audit
- Teams identified and the programme coordinated
- Outage Quality forum runs throughout the outage (at least weekly)





## Surveillance types

- *Subject Specific Safety and Quality Reviews* – These are specialist checks on high risk activities identified pre outage (e.g. Tasks Critical to Quality) and areas of concern that have been identified during the outage. They are performed by subject matter experts.
- *Task Observation* – These activities look at Human Performance aspects of work. A weekly report is provided to the Quality forum to ensure appropriate countermeasures are put in place for adverse trends.
- *General Safety/Quality Inspections* - These surveillances are carried out by EDF Energy staff and contractors as agreed by the Outage Quality Forum and are direct observation of activities, with the intention of minimising disruption to work.



# Nuclear Site Licence arrangements

- Prior to Reactor Start Up a report is produced for the ONR Start Up meeting detailing all audits/surveillances carried out, any major findings and corrective actions and whether these corrective actions are linked to reactor start up.
- A report describing the activities undertaken as part of the outage QA programme is prepared for inclusion as a specific section in the 28 Day (post outage) report. This includes summaries of activities conducted, findings and corrective actions identified in the pre outage, execution and close out phases



## OEF – It's All About Quality

This 1" Saunders valve had an inappropriate diaphragm fitted in an outage. The diaphragm failed challenging Environmental and Industrial safety.

### The cost of this event: -

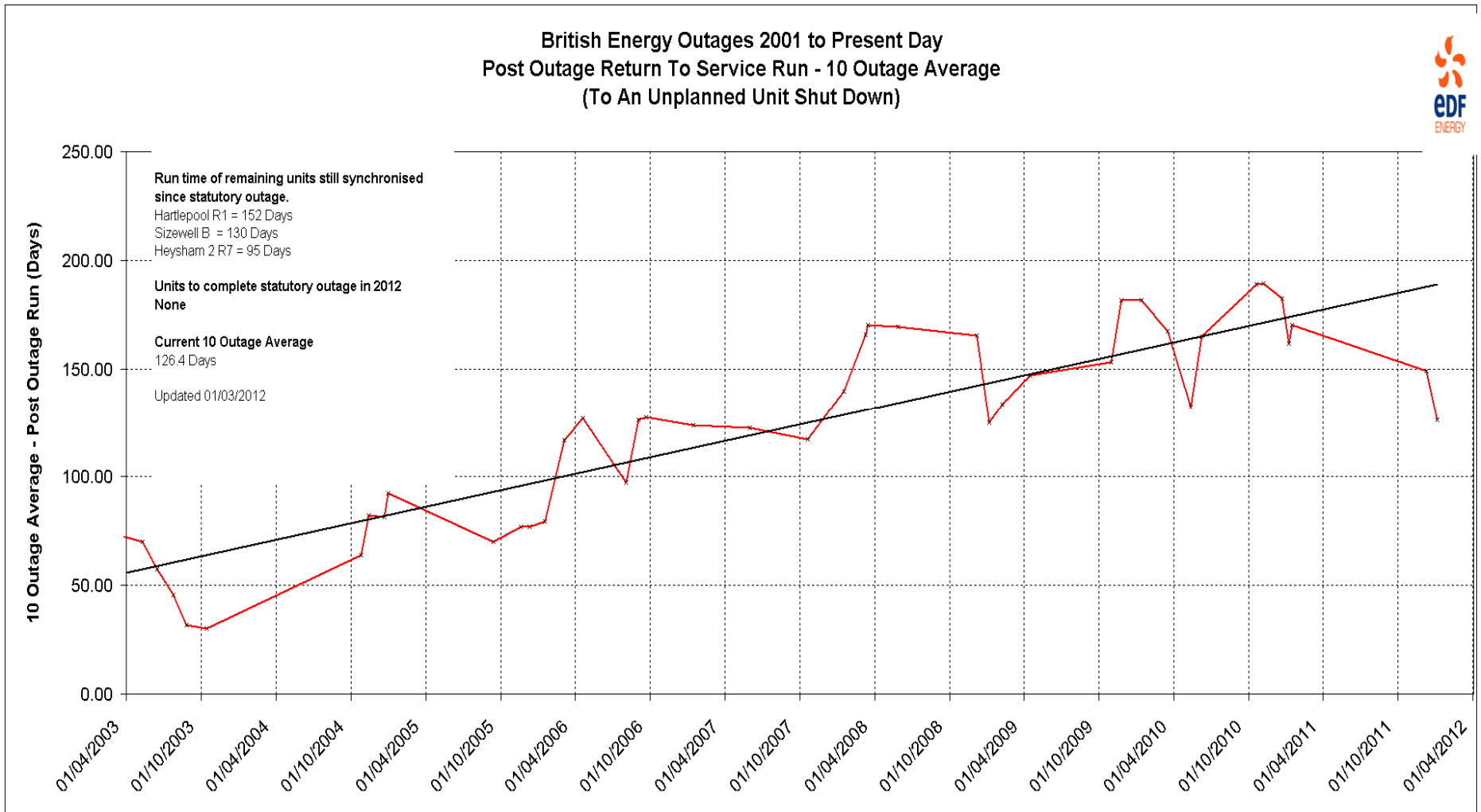
- 2.5 tonnes of Sulphuric Acid leaked giving off toxic fumes
- Site incident declared
- Mustering of 750 staff (Day 33 of statutory overhaul)
- Impact of 18 hours on outage critical path costing approx £750,000
- Local community concerns over emergency services to a nuclear power plant
- Media interest from local and national networks



**COST OF THE CORRECT  
DIAPHRAGM - £16.**



# Outage Key Results – Quality



Questions?

