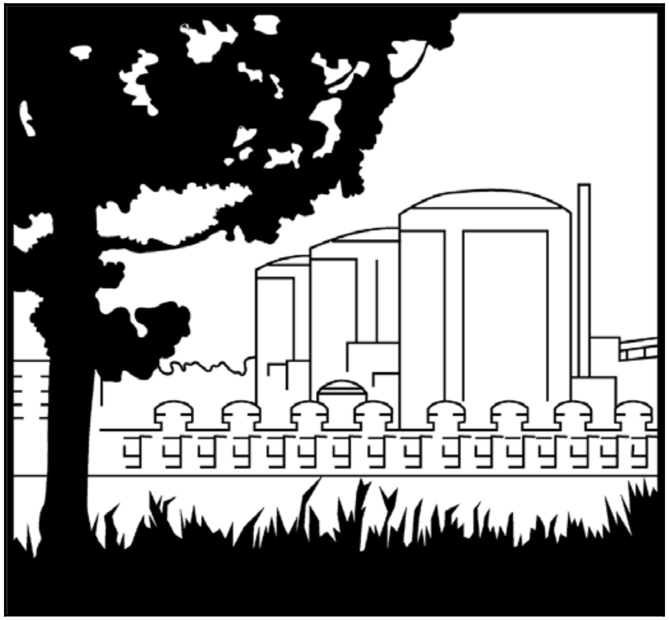

Non-Power Operation Transition

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Background

- NFPA 805 requires the evaluation of the effects of a fire
  - "During any operational mode and plant configuration"
- Concept introduced in NUREG 1449
- Building on NUMARC 93-01 and 91-06

NEI 04-02 Methodology

- Detailed methodology provided in NEI 04-02, Appendix F:
  - Review existing plant outage processes to determine equipment relied upon to provide Key Safety Functions
  - Compare list of SSCs required to maintain KSFs with those analyzed for Safe Shutdown at Power
  - For those SSCs not already credited, perform circuit/cable/routing analysis to determine where these SSCs can be impacted by fire

NEI 04-02 Methodology

- Detailed methodology provided in NEI 04-02, Appendix F continued:
  - Identify locations where fire may impact shutdown safety
    - Pinch Points where fire damage may prevent achieving KSFs
    - Recovery actions credited for KSFs are performed
  - Identify fire areas where a single fire may damage all the credited paths for a KSF.
    - May include fire modeling

NEI 04-02 Methodology

- Focus on managing fire risk Qualitatively during High Risk Evolutions (HREs)
  - NEI 91-06 defines High Risk Evolutions as follows:
    - Outage activities, plant configurations or conditions during shutdown where the plant is more susceptible to an event causing the loss of a key safety function
  - For this effort the "high risk evolution" to be reviewed is when the plant's operational state meets the following conditions, thus a high risk condition:
    - Fuel in the reactor, AND
    - Thermal margin is low with a time to core boil ≤ 40 minutes, OR
    - The plant is in a reduced inventory condition (i.e. water level ≤ reactor vessel flange)

Areas of Contention

- The NRC has endorsed NEI 04-02 without exception on non-power operational modes in RG 1.205.
- NRC expressed concern over the definition of high risk evolution.

What will be do?

- The industry has been challenged to propose a method for addressing fire-induced high risk evolutions (as opposed to addressing fire risk during “high risk” evolutions).

The Plan

- Incorporate Fire into the current Outage Defense in Depth method. (Actually the effects of a fire are already required to be addressed, we will implement a more exacting methodology).
- Take the concept of High Risk Evolution used in NEI 04-02 and apply it to what is really required to protect Key Safety Functions.

Definitions

- **Defense in Depth** – For the purpose of managing risk during shutdown, DID is the concept of:
  - Providing SSC's to ensure backup to Key Safety Functions using redundant, alternate, or diverse methods
  - Planning and scheduling outage activities in a manner that optimizes safety system availability.
  - Planning and scheduling outage activities to include redundant personnel reviews or approvals prior to work start.
  - Providing administrative controls that support and/or supplement the above elements. Administrative controls could be additional reviews, approval sequences or personnel involvement.
  - Providing the plans necessary to minimize the likelihood of losing a Key Safety Function.

Definitions
(Continued)

- **Key Safety Functions** – The functions that ensure the integrity of the reactor coolant pressure boundary, ensure the capability to shutdown and maintain the reactor in a safe shutdown condition, and ensure the capability to prevent or mitigate the consequences of accidents that could result in potentially significant offsite exposures. These key safety functions are:
  - Decay heat Removal
  - Reactor Coolant Inventory Control
  - Reactivity Control
  - Containment Control
  - Spent Fuel Cooling
  - Power Availability

Definitions
(Continued)

- **High Risk Evolutions** – Outage activities, plant configurations or conditions during shutdown where the plant is more susceptible to an event causing the loss of a Key Safety Function. High Risk Evolutions include:
  - Draining to Reduced Inventory when the reactor coolant level is at or below the reactor vessel flange
  - Reactor Coolant System at or below Reduced Inventory
  - Midloop operation
  - Any specific evolution determined by Station Management

What does the Industry do?

- Use an outage risk assessment tool
- Look for places where Key Safety Systems may be compromised during outage planning and during an outage.
- Put tools into place that allow Operations the ability to track and maintain a required level of safety with regard to Key Safety Functions at any time.
- Provide the needed tools to ensure that Key Safety Functions are maintain at or above required levels at all times.
- Provide contingency plans for whenever the required level of Key Safety Functions cannot be met.

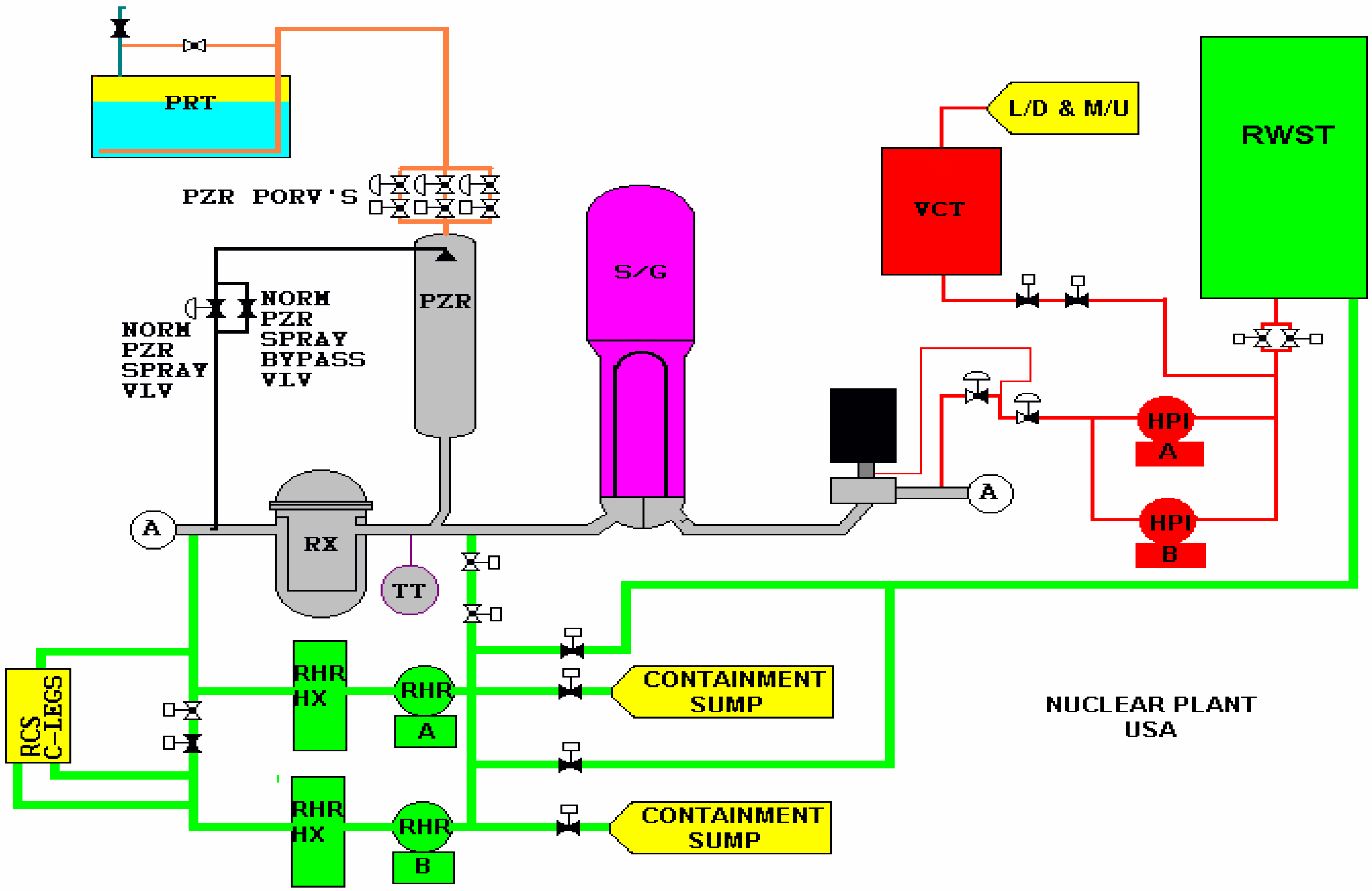
What does this look like?

- In order to best illustrate how this would be used and how we propose incorporating the NFPA-805 into the existing process, let's look at:

Nuclear Plant – USA

(or NP-USA for short)

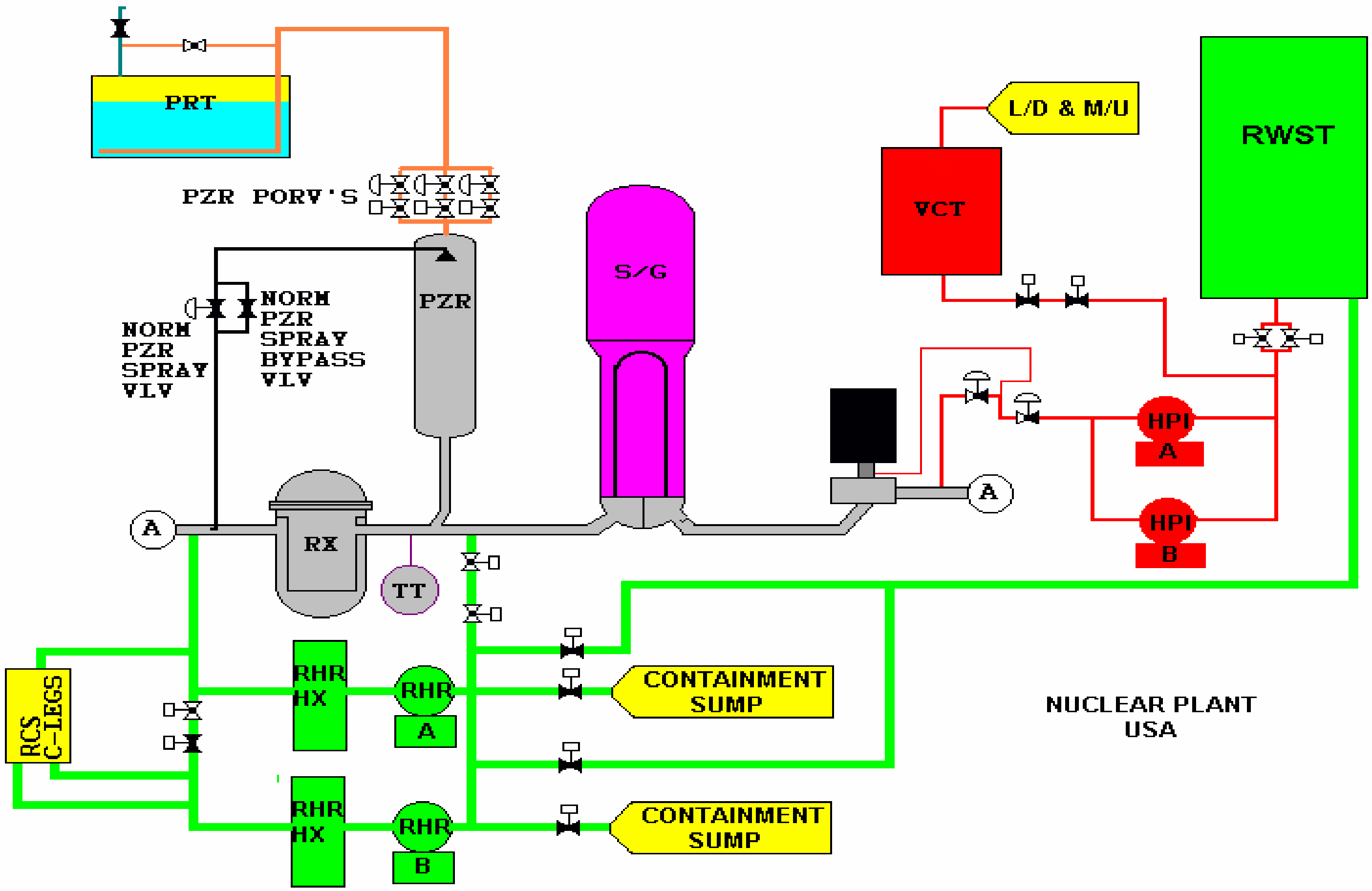
Nuclear Plant - USA



Outage Keys

- RCS Inventory Addition paths
  - Forced Injection
  - Gravity Flow
- RCS Vent Paths
  - Intact RCS
  - LTOP Vent Path
  - Large Vent Path
- RCS Level
  - Loops Filled
  - Loops Not Filled
  - Reduced Inventory
  - Midloop
- Decay Heat
  - High Decay Heat
  - Low Decay Heat
- Residual Heat Removal
  - RHR
  - S/G's
- Power
- Support Systems

Nuclear Plant - USA



Example 1

Outage Configuration – Mid-loop in High Decay Heat Condition

- Keys:
  - No large vent path established, thus forced injection required
  - Draining below Loops Filled condition – S/G's cannot be used
  - High Decay Heat – short time for operators to respond to a loss of RHR
- Requirements:
  - 2 trains of decay heat removal required and protected
  - 2 trains of forced injection required and protected
    - Maintain 1 HPI pump on each train
  - 2 trains of electrical power and support systems and protected
  - Containment Closure required
  - Minimum Control Room accessibility

Example 2

Outage Configuration – Draining the RCS to below the flange in High Decay Heat Condition

- Keys:
  - No large vent path established, thus forced injection required
  - Draining below Loops Filled condition – S/G's cannot be used
  - High Decay Heat – short time for operators to respond to a loss of RHR
  - Recognized risk because of limited venting while draining, instrument errors, OE on loss of RHR during evolution, etc.
- Requirements:
  - 2 trains of decay heat removal required and protected
  - 2 trains of forced injection required and protected
    - Maintain 1 HPI pump on each train
  - 2 trains of electrical power and support systems and protected
  - Containment Closure required
  - Minimum Control Room accessibility

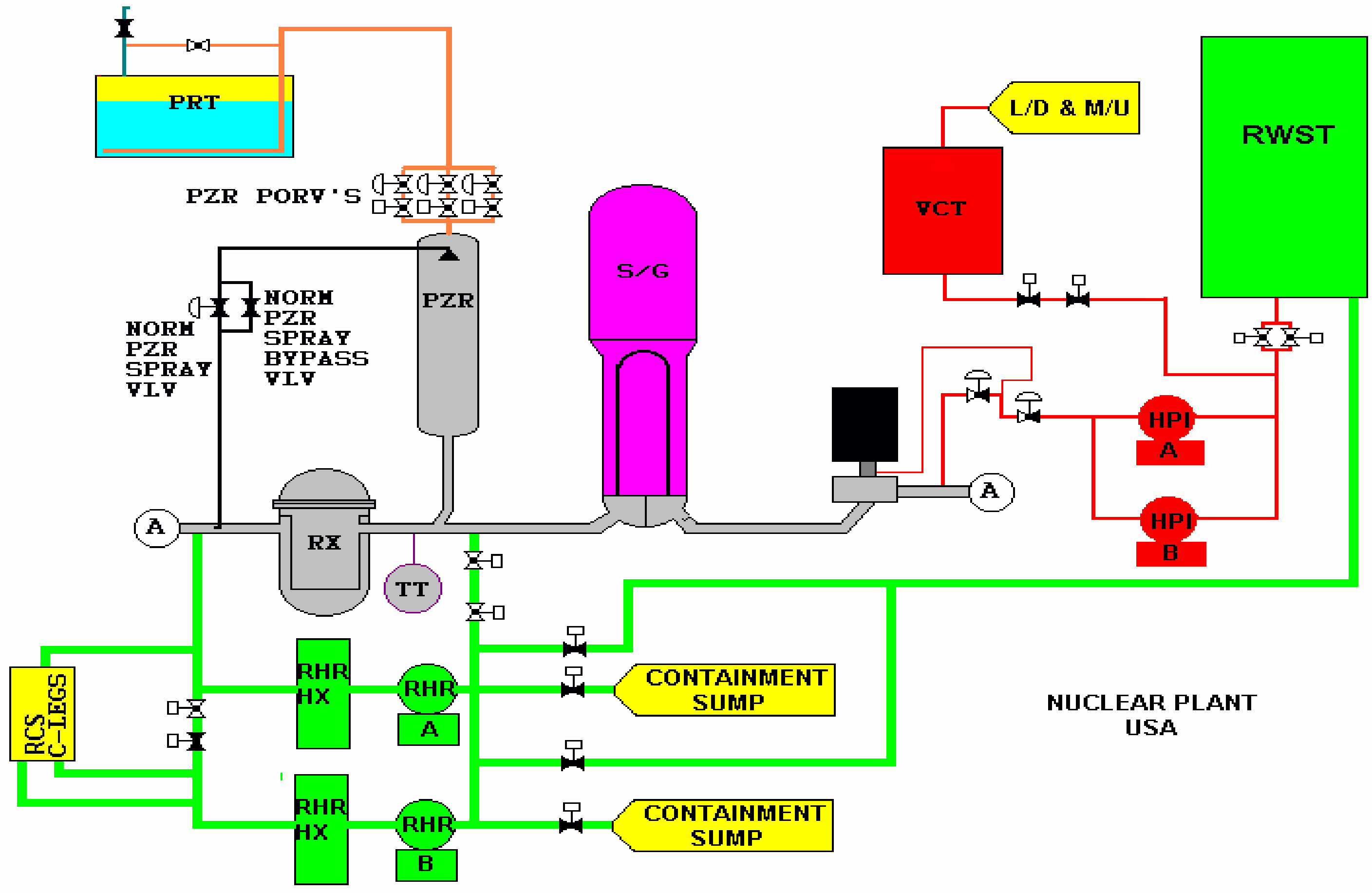
What about fire?

- Is there anywhere where a fire can cause the loss of all Key Safety Functions?
  - Keys:
    - Is there anywhere in the plant where all the KSF cables are routed together?
    - Is there anywhere where all the KSF equipment is located within a single fire area?
    - If a local operator actions is required, is there enough time prior to core damage for the operator to respond? Is the local operator action outside the fire area?
    - Is there any outage work ongoing in the at risk fire areas?
    - Will the operators be able to recognize a fire has happened in order to respond?
    - Establish contingency plans for loss of different levels of defense in depth

What about fire?

- NFPA-805 and NEI 04-02 Requirements:
  - Ensure that the operators can recognize and properly respond in time to a fire to protect the core. Typically the riskier evolutions are during periods of low RCS inventory and high decay heat.
  - Know where plant cables and equipment are with respect to a given fire area
  - Factor work in risk significant fire areas into outage planning
  - Understand what defense in depth is required during the outage and will a single fire jeopardize the protection of the core
  - Use administrative controls for outage activities that can potentially cause a fire
  - If a local operator action is required, ensure adequate time and feasibility exist to carry out the action.

Nuclear Plant - USA



Possible Vulnerabilities and Solutions Examples

- RHR suction valves – turn off power to valves
- RHR flow diversion flow paths – turn off power to valves or use a manual valve to isolate
- Both trains of protected equipment are located in a single fire area – set a fire watch, do allow personnel near protected equipment, etc.
- If Gravity flow path is an option –implement a local action, ensure containment closure possible, dedicate an operator, etc

Summary

- Fire will became a built in factor to existing outage risk methodology.
- Fire vulnerabilities for higher risk areas and evolutions will be identified as a part of outage planning
- Fire risk will be addressed using defense in depth methodology
- Contingency plans will be made available to the operators for higher risk evolutions
- Operator timeline must be verified for defense in depth responses.