The Review of Process on Choosing Layup Methods for Preserving Secondary System or Component during Abnormal Environment at "A" NPPs

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1. Introduction

It is quite common to have many plant systems and components open refueling, inspections, maintenance and repairs during an outage. Plant outage for repairs, refueling and/or maintenance may be as short as a few days to as long as several months depending upon the reason for and the nature of the outage.

Nuclear power plants are careful in selecting preservation methods because when the system is opened during the outage period, it is exposed to air and corrosion occurs. Since the oxides generated during the shutdown period are generated in an oxidizing environment, when they are getting into the steam generator, the corrosion product (or deposits) not only oxidize the constituent materials but also increase the ECP (Electrochemical potential). And elevated electrochemical potential increases the rates of IGA/SCC of steam generator tube (Alloy 600) in many chemical environments [1].

In general, in order to minimize material corrosion during Overhaul periods, wet layup preservation is applied to steam generators, and dry layup preservation is applied to the remaining secondary system. However, the A nuclear power plant is in a state of readiness for operation due to an unexpected incident that occurred after the pure water for operation was makeup in the secondary system.

CRI considered which preservation methods would be appropriate to apply in these situations. In order to choose appropriate layup method, CRI reviewed overseas nuclear power plant application cases, types of preservation methods and considerations for selecting a layup method, etc. Based on these data, the best layup method was selected for the current status of nuclear power plant A.

2. Methods and Results

In order to select the best preservation method, CRI looked into the preservation methods applied to nuclear power plants at first. Secondly, CRI looked into the factors to consider when selecting a layup method. Finally, CRI used logic flow chart for selecting a preservation method developed by a foreign nuclear power plant to select the best layup method considering the situation of nuclear plant "A"

2.1 The Types of Layup Methods

Although layup can be classified in various ways depending on the additional processing applied to the basic layup method, the preservation methods applied to nuclear power plants can be broadly classified into two types: wet and dry. Based on the two methods, the layup methods can be classified as follows [2]:

- Wet layup: Open to atmosphere (WL): the wet layup in secondary system equipment generally consists of filling the components and connecting piping with demineralized water containing a large excess of hydrazine with the pH adjusted to $\geq$ 9.8 using volatile amines.
- Wet layup with nitrogen blanket (WL+N_2): the wet layup method which includes the use of a nitrogen gas blanket above the liquid level.
- Drained (DR): the layup method is draining of portions of the secondary system without any control of the layup environment. These portions of the secondary system are exposed to air throughout most of the outage.
- Drained with nitrogen blanket (DR+ N_2): the layup method involves draining the system or component with a nitrogen cover gas.
- Dry layup with forced air drying (DL w/FAD): the method of enhancing dray layup by circulating building air through the system or component to assist in the removal of residual moisture.
- Dry layup with dehumidified air (DL w/DAD): the use of this layup method involves circulating air dried to a relative humidity less than 40% from a dehumidification device into a system or a component.
- As is: for the "as is" layup condition, no special treatment is given the system/component after the plant has been shutdown. If the system/component is filled with water during plant operation, it remains filled with water with no additional chemical treatment.

2.2 Factors involving selection of layup method

In many nuclear plants, it was found that the process for selecting the appropriate layup method was not

approached in an organized, logical fashion. However, most nuclear power plants select layup methods by considering the following factors:

- Outage duration: the duration of the outage can directly affect the choice for the layup method. If maintenance on a given component will require the entire outage to complete, obviously little can be done to place that component in layup.
- Convenience: the layup method employed must be easily implemented in a timely manner, e.g.
- Organization: Plant that has dedicated layup teams with a layup coordinator were able to facilitate timely and routine plant layup of selected components/systems.
- Plant design: the design of the plant can affect the selection of the layup method for certain system. For example, the piping supports for the main steam lines are not generally designed to carry the load if these lines were to be filled with water.
- Materials of construction: another factor in choosing the layup method is the materials of construction. Corrosion resistant materials will generally require less attention than materials like carbon steel.
- Contaminated waste: the selected layup method must not generate contaminated wastes that are incompatible with the plant's radwaste processing system or volumes.
- Other factors: perceived benefits and past experience

2.3 Decision Flow Chart for Selecting Layup Method

Some overseas nuclear power plants have developed a layup selection logic flow chart for the most efficient preservation program. In the logic flow diagram, the steam generator basically used the wet layup and the rest uses the dry layup. The remaining secondary systems, excluding the steam generator (category 1), were classified into four categories considering the convenience of layup methods. And the main system layup method is selected and applied depending on the period (fig. 1).

According to this logical flow diagram, considering the current state of power plant A, it falls under category 5 because the layup method is more than 15 weeks. If it falls under category 5, it is considered reasonable to perform wet layup for the SG and dry layup for the rest (fig. 2). But, the logic flow chart simply selects a different layup method for a given period and does not reflect the field situation. Therefore, if the field situation is reflected, it is reasonable to apply the wet layup method.

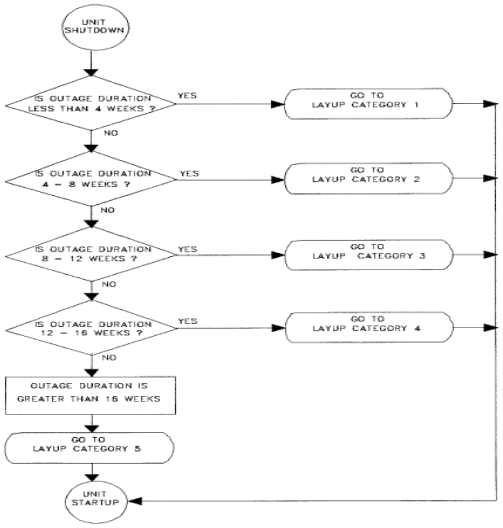

Fig. 1. Logical flow chart of the layup method of the relevant system according to the period of outage

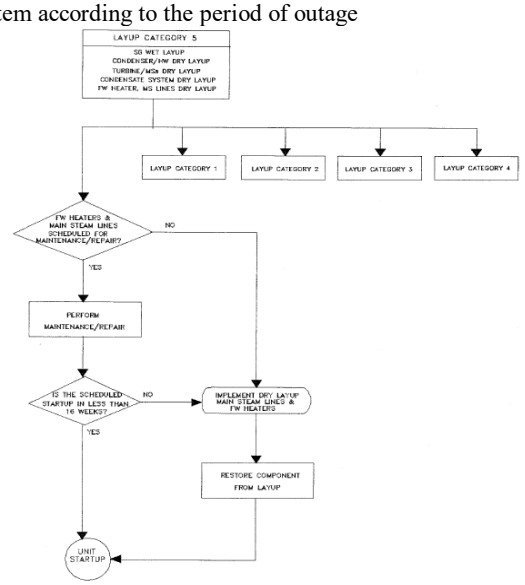

Fig. 2. Category 5 according to outage period of 15 weeks or more among 5 categories.

3. Conclusions

"A" nuclear power plant is in a state where the system is filled with water (not treatment) due to an unexpected event during startup. The best layup in this situation was reviewed. Considering the layup method, period, and convenience, it seems reasonable to apply the wet layup method.

REFERENCES

[1] Source Book on Limiting Exposure to Startup Oxidants, EPRI, Palo Alto, CA: 1999. TR-112967.
[2 Source Book for Plant Layup and Equipment Preservation (Revision 1), EPRI, Palo Alto, CA: 1992. NP-5106.