[redacted]

ıbmitted with Westinghouse letter

⁷-NRC-92-3779, December 15, 1992

Attachment to NPDP-FS-0067, June 2, 1988

AP600

PRELIMINARY REFUELING OUTAGE PLAN

DESCRIPTION OF PERT CHART ACTIVITIES

MAY 25, 1988

T. K. MENEELY

WESTINGHOUSE ELECTRIC CORPORATION

Enclosure 1

[redacted]

[redacted]

PLANT FEATURES

The following features of the AP600 plant have affected or could affect the refueling plan.

1. There is an integrated reactor vessel head package. This significantly affects many of the head dissemble and reassembly steps.

2. The reactor coolant pumps have canned motors, and therefore do not require any routine maintenance during the refueling. The elimination of shaft seals is also important during startup, because the only limiting factor on RCP operation at low RCS pressure is pump NPSH, not seal differential pressure. Assumptions were also made about the maintenance and inspection of the RCP's; see below.

3. The Chemical and Volume Control System, Spent Fuel Cooling System, and Liquid Waste Processing System provide excellent shutdown purification and degasing, which helps eliminate these functions from the critical path of the shutdown.

2. There are no loop isolation or stop valves; therefore steam generator nozzle dams must be used for steam generator maintenance.

3. All parts of the RCS exposed to coolant during refueling will be stainless steel (solid or clad), especially the outer bolt circle on the reactor vessel, which has traditionally been carbon steel.

4. The steam generator nozzle plugs have been redesigned, and will be effective and quick to install and remove.

5. The Integrated Protection System is self checking and calibrating, which saves several hours of manual calibration during startup.

6. A Sigma refueling machine will be used, with the capability to handle fuel assemblies, control rods, and any other core parts integrated into one machine.

7. The reactor coolant pump motor cans will not be designed for vacuum degasing.

[redacted]

ASSUMPTIONS AND BASES

These are items about which an assumption was made in order to allow the preliminary refueling study to be completed in the absence of a final plant design and utility specific refueling plan. Items 1 through 8 involve the limitations and simplifying assumptions made at the beginning of this study. The other items involve areas of the AP600 design where detailed designs have not yet been completed or where the utility has options involving the refueling process.

1. The primary side refueling operations have been studied exclusively, assuming that they will be critical path.
2. The outage studied represents a typical trouble free refueling outage for a mature AP600 design plant, more than 10 years old, with no unusual equipment repair, infrequent (less than once per five years) inservice inspection, or plant modifications.
3. The schedule will encompass the time from the initial reduction from full power to the return to full power.
4. There will be no reactor coolant pump maintenance, assuming the the canned motor design requires attention only during major Inservice Inspection (once per ten years).
5. There will be only normal steam generator tube inspection and plugging; major sleeving operations will not be required.
6. There will be no replacement of rod control clusters or control rods.
7. The Technical Specifications will allow Mode 6 to be entered at 160°F rather than the current 140°F.
8. There will be no unusual fuel inspections which would require the entire core to be removed to the spent fuel pit; fuel shuffle will be used for those fuel assemblies not being replaced.
9. All shutdown operations will proceed 24 hours per day, 7 days per week.
10. Core bypass calculations will assume that thimble plugs are not used, and these results will be considered in the reactor power capability calculations. Note that if thimble plugs were to be used, their removal and replacement would require 0.25 hours per thimble plug, which would be a direct extension of the outage.
11. No burnable poison rods will be required.

... containment prior to the shutdown and ...

[redacted]

assemblies).

14. The upper internals lift rig will be designed to remain on the upper internals during refueling, so that only one installation and removal will be necessary.
15. The cavity ladder will be designed to be left in the cavity and is permanently attached.
16. The fuel transfer tube will have a quick action flange inside the containment.
17. Clasp type mirror insulation will be used on the vessel head.
18. A single pass stud tensioning system will be used; there will be no requirement to tension several times at different temperatures. This is a relatively new system, but has been used on existing plants (e.g. Braidwood).

[redacted]

DESCRIPTION OF REFUELING OPERATIONS:

This list is an item by item description of the attached PERT chart. The item numbers are keyed to that chart. Sufficient detail is provided in this list to give the AP600 refueling outage design basis; in particular, items where the AP600 design is different from existing designs are discussed.

1. Containment Atmosphere Cleanup via Internal Filter
   COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific information has been used. The AP600 containment internal filtration system can be operated any time without restriction.
   TIME REQUIREMENT / NOTES: This activity can start at any time prior to refueling in order to ensure that it is not on the critical path.

5. CVCS Demineralization at 100 GPM
   This is a continuation of the normal CVCS demineralization process, and is shown for completeness. In particular, this is an important input to the shutdown purification calculations, because in the past CVCS purification has sometimes been critical path.
   COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information has been used.
   TIME REQUIREMENT / NOTES: This process has been ongoing continuously throughout power operation. It will continue normally until the last reactor coolant pump is stopped, at which point feed and bleed style purification and degasification will take over.

10. CVCS Gas Stripping
   Divert fluid from the CVCS letdown line out of containment to the waste processing system degasifier, strip the hydrogen and radiogases, and pump the fluid back into the RCS. The hydrogen level will be reduced to 5 cc per kg, and the radiogases to 0.05 microcuries per gram.
   COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information has been used. Most Westinghouse plants perform gas stripping in the volume control tank; however, the AP600 incorporates a degasifier in the Liquid Waste Processing System.

[redacted]

down and so should not be critical path. Preliminary calculations for AP600 show that 48 hours after shutdown is approximately the time required before the RCS pressure boundary can be breached without excessive occupational radiation exposure to refueling personnel.

15. Align Valves / Start Containment Purge
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 38 hours has been assumed to be required prior to allowing general access to the containment. This actual time will depend upon the effectiveness and operation of the internal containment filtration system, and will require more detailed design work than is currently available.

20. Add Hydrogen Peroxide / Purify Coolant (CVCS & SFCS)
COMPARISON TO TYPICAL REFUELING OUTAGE: This operation is used by most existing plants, adding hydrogen peroxide to oxygenate the RCS rapidly and promote the release of crud so that it can be removed by demineralization.
TIME REQUIREMENT / NOTES: Hydrogen peroxide generally is not added until the coolant temperature reaches 180^{o}F and the dissolved hydrogen in the coolant is at very low levels. 24 hours has been used as the total time required for adding the peroxide and removing the subsequent crud released to acceptable levels, based on preliminary AP600 shutdown purification calculations.

100. Shut down reactor 100-0%; Boration 0 - 900 ppm.
Insert the control rods to reduce power at approximately 1% per minute and borate the RCS using the CVCS.
COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information has been used. There are no changes in the general design basis relative to existing plants.
TIME REQUIREMENT / NOTES: The CVCS can perform this boration in 2.8 hours assuming a flow rate of 60 gpm (one CVCS makeup pump) and 2.5 weight percent boric acid.

[redacted]

Cool from hot shutdown to Spent Fuel Cooling System intitiation temperature using the steam generators to remove heat from the RCS and dumping the heat to the condensor.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants .
TIME REQUIREMENT / NOTES: Five hours is a 50^{o}F per hour cooldown plus some margin.

107. HP Inspection.
Inspection of the containment by the plant Health Physics department to determine radiation levels and establish working conditions and controls.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: The time requirement of 5 hours is based on the best estimate of experience refueling personnel, and supported by existing good refueling plans.

110. Initiate RHR (SFCS) and cool to 180^{o}F.
This is the design basis cooldown from hot standby temperature to cold shutdown, and the point at which hydrogen peroxide can be added to the RCS to provide oxygenation and release of crud. Mode 5 is achieved at 200^{o}F, but does not represent a significant milestone.
COMPARISON TO TYPICAL REFUELING OUTAGE: Based on AP600 specific system designs; otherwise assumed to be similar to existing plants. Note that the SFCS cools the reactor from this point on rather than the traditional dedicated RHR System.
TIME REQUIREMENT / NOTES: 6 hours based on AP600 calculations.

115. Cool RCS to 160^{o}F, Mode 6.
This is the temperature at which breach of the RCS pressure boundary for refueling is allowable, although the equipment is still too hot for comfortable handling. Some mode 6 work - such as venting the RCS and disconnecting the CRDM cables - is not dependent on direct contact with the metal in the system and therefore can begin as soon as mode 6 is achieved.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to

160^{o}F.

TIME REQUIREMENT / NOTES: 10 hours is required for the current AP600 SFCS.

116. Vent Reactor Vessel Head

Before the studs are detensioned the head is vented to ensure that there are no radiogases or hydrogen, which might have accumulated during depressurization. This also ensures and demonstrates that the RCS is fully depressurized, and breaks the vacuum in the head, to allow the coolant to drain.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be generally similar to existing plants, except that the AP600 head vent line is fully manual, and existing plants have a TMI required remotely operated vent. This will have no effect on the operation of the head vent in this instance, since people will be working directly in the head area.

TIME REQUIREMENT / NOTES: One hour is assumed. This is adequate time to have a worker go to the vent valves, open them, and allow some period of free venting before continuing.

117. Cool RCS to 130^{o}F (Access to RV Head)

130^{o}F was assumed to be the highest temperature at which any work could be started with workers in direct contact with the metal of the reactor vessel head. At this point it would be possible to begin detensioning the studs.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants, except that 130^{o}F is lower than the 140^{o}F which has traditionally been used as the milestone temperature. This change is based on utility input.

TIME REQUIREMENT / NOTES: The time requirement of 28 hours is based on the best estimate capability of the current Spent Fuel Cooling System.

120. Cool RCS to 120^{o}F

120^{o}F was assumed to be the highest temperature at which the cavity could be flooded, and therefore is potentially on the critical path. This activity covers cooldown and draining of the RCS from full and water solid to 4" below the flange.

COMPARISON TO TYPICAL REFUELING OUTAGE: Historic designs did not incorporate this temperature milestone; however, utilities have found that this degree of cooling is necessary. This temperature is based on utility input.

TIME REQUIREMENT / NOTES: The time requirement of 43 hours is based on the best estimate capability of the current Spent Fuel Cooling System.

202. Polar Crane Maintenance

Get the polar crane ready for use in disassembly and assembly functions.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 24 hours is based on typical historic requirements, and was selected so as to be off the critical path. This activity has sometimes been on the critical path of refuelings, but that implies that the polar crane was left in bad condition after the last shutdown. Work begins as soon as workers are allowed (by Health Physics) to enter containment.

204. Annulus Crane Maintenance

Similar to activity 202.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants, assuming AP600 has an annulus crane.

TIME REQUIREMENT / NOTES: Not on critical path, by design.

206. Verification Testing Head Lift Rig

Assure that the reactor vessel head lift rig is ready for use.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 10 hours based on historic plant data.

208. Head Hoist Maintenance

Assure that the head hoist gear is ready for use.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 20 hours based on historic plant data. Off critical path in any event, since work could begin any time after containment entry.

210. Decon. Operating Deck & Polar Crane
Establish radiological conditions within the containment to allow reasonable access to required working areas.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 36 hours based on historic plant data. Note that this work is in parallel with the polar crane maintenance activities (in spite of this task having a higher activity number), and tne two tasks would be coordinated.

215. Verification Testing of Upper Internals Lift Rig
Assure that the rig is ready for use.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 10 hours based on historic plant data.

220. Open Equipment Hatch
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 2 hours based on input from refueling personal. Note that this activity cannot occur until after Mode 6 has been achieved.

225. Move Westinghouse Refueling Tools into Containment
There are several boxes of special tooling which the refuelers supply, which are brought in on hand trucks. These tools would include stud handling tools and plugs, thimble handling tools, cleaning equipment, and other testing and inspection tools.
COMPARISON TO TYPICAL REFUELING OUTAGE: For some historic refueling operations there was much special tooling required which was not stored inside containment, and the movement of tools in was considered to be a large task. However, the modern practice for all plants has reduced this operation to one or two hand truck loads.
TIME REQUIREMENT / NOTES: 2 hours is allowed to give some margin for getting QA clearance and checkout, coordination of movement around containment, etc. This task cannot begin until the equipment

[redacted]

hatch is removed.

230. Remove Blind Flange on Fuel Transfer Canal
Remove the inside containment and outside containment blind flanges, preparatory to moving fuel through the fuel tube.
COMPARISON TO TYPICAL REFUELING OUTAGE: The AP600 is assumed to incorporate a quick action blind flange. Otherwise, assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 1 hour required, using a quick action blind flange which can be opened quickly with long tools. Note that this activity traditionally required up to 8 hours.

235. Manipulator Crane Checkout
Get the manipulator ready for use, in every respect except for positioning calibration, which cannot occur until the crane is actually brought into position ready to move fuel.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: The time requirement of 8 hours assumes only normal maintenance is required, and is based on input from refueling personnel.

240. Fuel Handling Equipment Dry Checkout
Assure that the equipment is ready for use.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 4 hours, as estimated by refueling personnel.

245. Long Handled Tool Checkout
Assure that tools are all present, in good condition, and ready to use.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 4 hour time allowance is based on input from refueling personnel and typical refueling outage figures.

248 Enter Mode 6 (160°F)

This is a milestone, defined by the Standard Technical Specifications as $K_{eff} \leq 0.95$, average coolant temperature $\leq 140^{o}F$. This is the point at which the containment can be opened, and at which the reactor vessel can be opened.
COMPARISON TO TYPICAL REFUELING OUTAGE: It has been assumed that we can get a minor modification to the Tech. Specs. for AP600 to increase this temperature to $160^{o}F$, in order to shorten the cooldown period required.
TIME REQUIREMENT / NOTES: Milestone only; no time requirement.

250. Disconnect CRDM & Rod Position Indication Cables
Remove all exterior attachments (instrumentation & control, seismic supports, piping connections) preparatory to lifting the Integrated Head.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants utilizing the Integrated Head Package. There are very significant benefits of having the IHP for a number of activities.
TIME REQUIREMENT / NOTES: There are 3 cables per CRDM, or 171 cables for the 57 CRDMs on the IHP. This time was noted to be possibly as short as four hours, rather than the twelve assumed; however, the refueling personnel in general felt that twelve hours was a more reasonable and demonstrable time. Since this activity is not on the critical path, it remains at twelve hours.

255. Disconnect Thermocouple Leads
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: Eight hours assumed. This activity is closely related to 250, and the time could vary considerable depending on how work progressed on that activity. Eight hours was the consensus of the refueling personnel available, based upon experience and input from IHP designers.

260. Remove Seismic Supports
For the AP600 with IHP, this involves disconnecting the seismic support arms on the head and swinging them up to the stowed position on the head. The maneuvering can probably be done with the jib

cranes supplied on the IHP; however, many current IHP designs require the use of the polar crane for this procedure.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants with IHP.
TIME REQUIREMENT / NOTES: Four hours assumed, which would be sufficient time to allow use of the polar crane for this operation. The IHP designers could not give guarantee that the on-head cranes would be adequate for the job; this apparently depends upon the exact location of the seismic supports and details on the head. If an on-head crane could be used, this task could potentially be shortened to two to three hours.

265. Remove cable tray and cables
This involves quick disconnection of the cables at the end of the tray and swinging the cable tray up to its stowed position on the head package. This operation requires the polar crane.
COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design was used. The AP600 reactor vessel head vent line is also on the cable tray, and must be disconnected first (see 290).
TIME REQUIREMENT / NOTES: The actual work involved could be "very quick", less than one hour. However, getting access and using the polar crane necessitated adding margin up to four hours total.

280. Disassemble conoseals & install bullets
This operation is to cover and seal instrumentation penetrations prior to flooding the cavity.
COMPARISON TO TYPICAL REFUELING OUTAGE: The is a relatively new bullet design now available from Westinghouse Pensacola which is light and fast two install, and which has been demonstrated to be useful. This bullet design is assumed to be used for AP600, with an installation time of 10 to 15 minutes per conoseal.
TIME REQUIREMENT / NOTES: Time requirement conservatively assumed to be three hours total.

285. Remove RV Head Insulation
This is removal of the clasp type reflective insulation to allow access to the studs.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to

any existing plant with clasp type insulation

TIME REQUIREMENT / NOTES: Four hours assumed, based on input from refueling personnel. This is probably conservatively long, but allows adequate time for getting access to the jib crane, storing the insulation, etc.

290. Remove RV Head Vent Lines

Disconnecting the head vent line which is routed across the cable tray. See 250, 265.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information used. AP600 has a totally manual head vent system, and a single line.

TIME REQUIREMENT / NOTES: Since the head vent line is routed over the cable tray, this task must be complete before the cable tray can be raised.

300. Detension RV Studs and Store on RV Head

Stretch the studs, loosen the head nuts, lift each studs, insert a spacer collar around each stud, insert a stud hole plug (activity 303), and store the studs back in their original hole in the reactor vessel head.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to any plant with an IHP.

TIME REQUIREMENT / NOTES: The 12 hours allotted is per the Forest Hills Integrated Head Package group. The IHP provides integral stud tensioners and handling tools and allows integral storing of the studs, which speeds the operation considerably. This activity basically shares time with activity 303, since they must be accomplished together.

303. Install hole plugs

Provide protection to the stud holes in the reactor vessel prior to flooding the area.

See activity 300.

305. Install Guide Studs

Install the three special long guide studs which will be used to keep the IHP aligned during the head lift and replacement.

[redacted]

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: Four hours allows time to align and install the guides; based on input from refueling personnel.

310. Remove all Equipment from Cavity

Gather up all tools, parts, etc. and generally police the area prior to flooding.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: Six hours is based on a typical outage plan. There is room for improvement by better organization of the workers from activity to activity, but refueling personnel believed that it would be unreasonable to shorten this time without a demonstrated improvement between AP600 and other plants.

315. Clean RX Cavity and RV Head

Establish Radiological conditions within the containment to allow reasonable access to required working areas.

This is a coordinated activity with 3.0 above.

320. Establish Refueling Control Area

Establish controlled access to containment areas used for refueling, post the appropriate security and health physics personnel, and prepare for flood up and head lift.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 6 hours is based on typical historic outages. This is primarily a QA activity.

325. Reactor Vessel Level at 4" Below Flange, Pre-flood

This is a milestone.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: This milestone occurs at the end of activity 120.

335. Flood Cavity to Top of Guide Studs, Lift Head

This involves connecting the polar crane to the head lift rig, lifting the head slightly, and flooding the cavity with the SFCS supply of refueling water through the reactor coolant system. After the flood up is well underway, the head is lifted off and moved to storage.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be generally similar to existing plants except for the general arrangement of the fluid systems, which are not critical path.

TIME REQUIREMENT / NOTES: The Spent Fuel Cooling System could supply water to fill the cavity more quickly than the 8 hours assumed here; however, a relatively slow flood is required to avoid a "Niagra Falls" effect of churning and splashing, which causes airborne problems. Eight hours was the quickest practical flood up, in the opinion of refueling personnel. In addition, the completion of the head lift may be done in conjunction with activity 350, flooding the cavity: many utilities prefer to follow the flood with the head to avoid shine out of the reactor vessel.

Also, it is possible to begin flooding the lower cavity before this point; a gravity flood from the IRWST could be started in parallel with activity 120 if an appropriate manual drain line was provided. Activity 335 could then be shortened to the time required to flood from the bottom of the vessel to the top of the guide studs. However, for conservatism the entire flood at has been retained at this point.

340. Unlatch and Verify Control Rod Drives

After the head has been lifted, unlatch the control rod drive rods from the clusters. QA verification that all the control rods clusters are disconnected from the drive rods is required.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information used (number of CRDMs and GRDMs).

TIME REQUIREMENT / NOTES: 10 hours, ratioed based on standard outages. No modifications were made to the time required to unlatch and verify one CRDM because the AP600 is not different from existing plants. However, this could be an area with improvements possible on the critical path of the refueling.

345. Install Upper Internals Lift Rig

Install the lift rig prior to removal and storage of the upper internals.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 4 hours required, per typical historic outage plans.

350. Raise Cavity Level to 27 feet

Continue flooding the cavity, using the SFCS to supply refueling water from the IRSWT.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific information was used pertaining to the arrangements of the fluid systems.

TIME REQUIREMENT / NOTES: 2 hours assumed, based on general estimate of the refueling cavity level and SFCS capabilities. (2250 gpm per 2 pumps will deliver the entire IRWST volume of 350,000 gallons in 1.3 hours.)

355. Remove and Store Upper Internals

Remove upper internals from the reactor vessel using the polar crane, and store in the upper internals storage rack.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific information used, especially the assumption that the upper internals lift rig can remain attached to the internals during storage so that removal and reinstallation time is saved. This is true of a few but not most existing plants.

TIME REQUIREMENT / NOTES: 4 hours, which is considered to be the minimum time by refueling personnel.

[illegible]. Start Cavity Filtration

Cut in the Spent Fuel Cooling System demineralization and filtration of the refueling water.

COMPARISON TO TYPICAL REFUELING OUTAGE: The AP600 assumes no separate cavity filtration system is required. This could normally become a critical path activity because clarity must be established before fuel shuffle can begin, and many utilities install portable filtration systems. AP600 assumes that the relatively high capacity of the CVCS purification during shutdown and the SFCS during cooldown, and the ability of the SFCS to purify the IRWST following

[redacted]

or prior to the shutdown, in conjunction with good refueling practices, with obviate the need for a separate system.
TIME REQUIREMENT / NOTES: This is a milestone only; no time is considered to be required.

375. Verify Manipulator Crane Indexing
Assures proper positioning of crane for removal of fuel assemblies. This is a QA required activity.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be no different from existing plants. However, the new refueling machines may have some impact on this and other activities.
TIME REQUIREMENT / NOTES: 2 hours, based on typical refueling shutdown schedules.

380. Fuel System Wet Checkout
Assure that the fuel handling system is operating as anticipated.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 4 hours, based on typical refueling outage schedules and input from refueling personnel.

400. Fuel Shuffle - Core Mapping (1/3) New Fuel
COMPARISON TO TYPICAL REFUELING OUTAGE: The AP600 will assume one third of the core is replaced, or 48 out of 145 fuel assemblies. The other 97 assemblies are shuffled, not removed and replaced. There are 57 total control rods including gray rods.
TIME REQUIREMENT / NOTES: 44 hours, as broken down below. Note that the times shown are machine limited, thus a large amount of margin is included to convert to operator limited times. Also, note that although the industry average for this operation (including plants with more fuel assemblies, and plants which remove the entire core to the spent fuel pit) is 9.3 days, but one two loop plant without a Sigma refueling machine consistently performs the operation in 48 hours.

Step	#	Time
Discharge fuel assemblies to SFP	48	8.0 hrs
Shuffle fuel assemblies	97	8.1 hrs

	Total	16.1 hrs.
	100% Margin	16.1 hrs.
QA Verification of core load		12.0 hrs.
		44.2 hrs.

405. Pressurizer & Steam Line Safety Valve Bench Test

Remove the required valves from service. Verify that the setpoint of these valves is within the required band, and that the valves are operating correctly. Reinstall valves.

COMPARISON TO TYPICAL REFUELING OUTAGE: There are a variety of methods for testing safety valves, some of which require testing to be done during the plant's return to power, and which therefore could extend the shutdown if problems are encountered. Removal and bench testing has the disadvantage of requiring a significant amount of effort, but it assures that this testing will not impact the critical path of the outage.

TIME REQUIREMENT / NOTES: 100 hours is probably sufficient; the time is not critical, because this activity can start any time after the plant is cooled down, and must be completed only prior to startup.

410. QC Core Mapping Verification

A milestone: QC signs off that the fuel assemblies have been loaded according to plan. This is a verification (by TV camera) that the fuel assembly serial numbers actually installed correspond to the map.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: Milestone only.

425. Install Upper Internals

Begin reassembly of the reactor by installing the upper internals package. Use the polar crane to bring the package back from storage.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants. However, some savings was achieved by the fact

that the internals lift rig remained mounted on the internals package during the refueling, which eliminated and activity to reinstall the rig.
TIME REQUIREMENT / NOTES: 4 hours, based on typical traditional time requirements.

430. Remove Upper Internals Lift Rig
Remove and store the lift rig using the polar crane.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 4 hours, based on typical traditional time requirements.

435. Relatch & Drag Test Control Rod Drive Shafts
Reinstall the control rod drive shafts, connect them to the spiders, and perform drag tests to ensure that they are properly installed.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 10 hours, based on typical outage plans.

440. Remove & Install New RV O-ring
Remove the old O-ring from the vessel head, clean up the head area, and install the new O-ring.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 10 hours, based on typical outage plans. Note, however, that this activity could start any time after storage of the head, and should not impact the critical path.

445. Inspect New RV Head O-ring and Head Flange
A milestone: QC verification that the head has been properly prepared for reinstallation.

450. Dewater Cavity to RCS Level
Begin the transfer of refueling water from the cavity back into the IRWST, using the SFCS pumps and the reactor coolant drain tank system.
COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design infor

[redacted]

mation has been used, in particular for the designs of the fluid systems.

TIME REQUIREMENT / NOTES: At full SFCS flow of using one train for transfer, this could theoretically be accomplished in less than 3 hours. However, to allow margin for cooling to continue and to route as much of the refueling water as possible through the demineralizer and filter, 7 hours is assumed.

452. Clean Reactor Vessel Flange

Manually clean the Reactor Vessel flange to ensure proper sealing of the O-ring when the head is set.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 2 hours is used, based on input from refueling personnel.

455. Decontaminate - Hose Down Cavity Wall

During drain down of the refueling cavity, hose down the walls to begin the decontamination process and to reduce the airborne radiation level from evaporation of refueling water.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: This activity, by definition, should take the same amount of time as dewatering the reactor cavity.

460. Set Reactor Vessel Head

Using the polar crane, remove the vessel head from storage and replace it on the reactor vessel.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 6 hours, which is used by existing plants and recommended as reasonable by refueling personnel.

462. Decontaminate Lower Cavity

Use the technique that the utility selects to decontaminate the lower cavity.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: It is assumed that this technique is fairly modern, e.g. using stripable paint or hydrolasers, but credit is not taken for robotic designs currently under development. Thus, 10 hours is based on input from good but traditional outages.

463. Install Blind Flange on Fuel Transfer Canal
Reinstall the quick acting blind flange on the fuel transfer canal inside containment.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 1 hour required, using a quick action blind flange which can be opened quickly with long tools. Note that this activity traditionally required up to 8 hours.

465. Decontaminate Cavity (Upper)
Establish radiological conditions around the vessel area to allow reasonable access to required working areas.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: 20 hours, based on input from refueling personnel. This would seem to be an excellent candidate for reduction in the critical path; however, no improvement was incorporated because no design modifications have been made.

470. Remove Guide Studs
Remove and store the guide studs.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: Note that this activity is not critical path. Time required is conservatively long.

475. Remove Stud Hole Plugs and Clean RV Head Stud Holes
Remove protective plugs from stud holes and clean holes prior to installing RV head studs. Note that the cleaning is done through the stud holes and between the head flange and the vessel flange.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to any existing plant with Integrated Head Package.
TIME REQUIREMENT / NOTES: 10 hours, based on input from Integrated

[redacted]

Head design group and verified in discussions with refueling personnel.

480. Install RV Head Studs

Thread the studs back into the reactor vessel by removing their retaining collars and dropping them into position and screwing them in.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to any existing plant with Integrated Head Package.

TIME REQUIREMENT / NOTES: 10 hours, based on input from Integrated Head design group and verified in discussions with refueling personnel. Note that this time is considerable shorter than typical current design.

485. Tension RV Head Studs

Use the single pass multi-stud tensioner to tension the studs.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information used. A single pass multi-stud tensioner is assumed.

TIME REQUIREMENT / NOTES: 16 hours, based on information from refueling personnel at Braidwood.

495. Move Refueling Tools Out of Containment

Move the refueling contractors tools out of containment. This is usually about one hand truck full of tools.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 2 hours; see activity 225.

500. Install Reactor Vessel Insulation

See activity 285.

TIME REQUIREMENT / NOTES: 6 hours.

505. Install Reactor Vessel Head Vent

See activity 290.

TIME REQUIREMENT / NOTES: 2 hours

515. Remove Bullet Noses and Assemble Conoseals

[redacted]

TIME REQUIREMENT / NOTES: 2 hours.

520. Connect Thermocouple Leads
See activity 255.
TIME REQUIREMENT / NOTES: 10 hours.

525. Replace Cable Tray and Cables
See activity 265.
TIME REQUIREMENT / NOTES: 10 hours.

535. Install Seismic Supports
See activity 260.
TIME REQUIREMENT / NOTES: 6 hours.

545. Reconnect CRDM & RPI Cables and Conduit
See activity 250.
TIME REQUIREMENT / NOTES: 20 hours.

805. RCS Fill and Vent
Return the RCS to full water solid conditions. The RCS is filled with the SFCS and CVCS makeup pumps, trapping air in the vessel head and in the steam generator U tubes. Air is then vented from the head, and the reactor coolant pumps are successively "bumped" to suck the air out of the steam generator at the suction of the pump, and force reverse flow through the other steam generator, such that air is flushed into the vessel head for venting. The RCP is run until the motor current drops to the normal value, and the pump is then stopped. A significant amount of air redissolves into the coolant at each bump, and then reaccumulated throughout the high points in the RCS.
COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information used. AP600 has a different loop and reactor coolant pump design, both of which are significant in this operation. The canned motor RCPs will not allow the use of vacuum degasing, which would normally be recommended for shortening degasing time. However, there are no RCP seals, and so maintaining RCS pressure and seal differential pressure is not of concern. Also, there are two RCPs per steam generator, so that the heatup of RCP motors will not be as

limiting as it normally would be.

TIME REQUIREMENT / NOTES: 24 hours assumed. The RCS fill, trapping air in the vessel head and steam generator tubes, would require approximately two hours using the CVCS makeup pumps at 120 gpm. (This is conservative since the SFCS pumps could be used for part of the fill.) Air could be vented quite rapidly; however, refueling personnel state that experience shows that at least 3 reactor coolant pump runs per steam generator will be required. Thus the breakdown of times is assumed as follows:

- Initial Fill	2 hours
- First venting	1 hour
- Refill (300 ft^3)	1 hour
- Two RCP bumps	1 hour total
- Allow air to collect	1 hour
- Vent	1 hour
- Refill (1600 ft^3)	4 hours
- Two RCP bumps	1 hour total
- Allow air to collect	1 hour
- Vent	1 hour
- Refill (800 ft^3)	2 hours
- Two RCP bumps	1 hour total
- Allow air to collect	1 hour
- Vent	1 hour
- Refill (800 ft^3)	2 hours
- Margin for air collection, etc.	3 hours
	---------
	24 hours

This is a highly conservative schedule; the 1600 cubic foot refill assumes that all of the air in the steam generator tubes is gathered in one bump, and the 800 cubic foot refills assume that half of the air in the steam generator tubes collects each time; i.e. twice the amount of trapped air is actually vented.

810. Replace Containment Equipment Hatch

Replace and locally test the containment equipment hatch.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 8 hours, based on input from refueling planners and typical outage schedules.

815. Valve Lineup / Leave SFCS

Isolate the SFCS from the RCS.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 12 hours, assumed to be comprised of approximately 10 hours to realign the valves, and 2 hours for QA verification of the valve positions.

820. Leave Cold Shutdown; RCS Heatup to 250°F

Heat up on RCP motor heat to 250°F. After heat up, check for leaks, establish a steam bubble in the pressurizer, and check the RCS for leaks. Also, by 180°F, establish the RCS chemistry to be within the allowable oxygen limits.

COMPARISON TO TYPICAL REFUELING OUTAGE: Heatup rate based on AP600 specific design calculations for heat input of the reactor coolant pumps to the RCS mass.

TIME REQUIREMENT / NOTES: 24 hours total. The actual time required to heat up would be approximately 3 hours, and the establishment of the steam bubble would require 1 to 2 hours. The actual critical path of the heatup operation is normally oxygen scavenging and verification, and buttoning up various leaks.

Chemistry input is that oxygen scavenging with hydrozine will be possible in 12 to 18 hours. The 24 hour total is based on input from refueling personnel, but appears to be reasonable (an possible somewhat short.)

This activity will be broken down into two parallel activities for clarity.

830. RCS Heatup to 547°F

Use reactor coolant pump heat and the pressurizer heaters to continue the heatup from 250°F to 547°F while maintaining RCS chemistry and continuing to watch for leaks.

COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 specific design information used. This activity could be shortened if nuclear heatup was employed.

TIME REQUIREMENT / NOTES: 30 hours, based on input from refueling planners. This number is expected to be conservative (adiabatic heatup requires less that 12 hours) and should be recalculated, but this work is not yet complete.

835. Close Reactor Trip Breakers
Bring the control rods back into operation.
COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.
TIME REQUIREMENT / NOTES: Milestone only, no time required.

840. Control Rod Slave Cycle Timing Test
See activity 900.
TIME REQUIREMENT / NOTES: 22 hours.

845. Rod Bank Overlap Test
See activity 900.
TIME REQUIREMENT / NOTES: 6 hours.

850. Hot Rod Drop Test
See activity 900.
TIME REQUIREMENT / NOTES: 2 hours.

855. RTD Cross Calibration Test
See activity 900.
TIME REQUIREMENT / NOTES: 6 hours

900. Zero Power Physics Testing
This activity consists of withdrawing the shutdown banks, setting the other control rods to calculated positions for hot zero power, and diluting the boron out of the RCS to criticality. The reactivity meter is checked out, and the nuclear heating level calculated. All rods are then withdrawn, and the boron worth and moderator temperature coefficient are verified to be within the allowable Technical Specification ranges. The control rod banks are then diluted back in, and reactivity worth measured for comparison to the core acceptance criteria.
COMPARISON TO TYPICAL REFUELING OUTAGE: AP600 is assumed to have these physics tests done per ANSI 19.6.1-1985, and to use rod swap to reduce the number of rod banks diluted in from four to two.

[redacted]

TIME REQUIREMENT / NOTES: 25 hours currently used. This is based on input from NTSD Nuclear Operations (E&CS-WCG-450, 2/19/88) which indicates that Farley has performed these tests in approximately 16 hours, not including the time to dilute to criticality. This dilution requires about 2 to 4 hours, so 20 hours is probably actually required; 25 hours includes some (unnecessary) margin.

905. Clear and Open Main Steam Isolation Valves

Begin to re-establish the primary to secondary interface.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 5 hours, for miscellaneous work on the MSIV's and steam lines.

910. Post Outage Turbine Checkout

Verify that the turbine is ready to be rolled.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 4 hours, which assumes that no major turbine work was performed or that most of the verification was done as part of the work.

915. Unit On Line

Sycronize the turbine - generator to the grid and reconnect.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 5 hours allowed for interface with the dispatcher, etc.

920. To 100% Power at 3% per hour rate

Return to full power within the fuel design limits. Note that there would actually be some hold points for physics testing in this ramp, but adequate time allowance is included in the return to power time.

COMPARISON TO TYPICAL REFUELING OUTAGE: Assumed to be similar to existing plants.

TIME REQUIREMENT / NOTES: 34 hours, which includes the time to heat up and also to run the appropriate physics testing.

Westinghouse
Electric Corporation

Energy Systems

Box 355
Pittsburgh Pennsylvania 15230-0355

DCP/NRC1409
NSD-NRC-98-5753
Docket No. 52-003

August 13, 1998

Acc # 9808200180

Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: RESPONSE TO NRC LETTERS CONCERNING REQUEST FOR WITHHOLDING INFORMATION

Reference:

1. Letter, Sebrosky to McIntyre, "Request for withholding proprietary information for Westinghouse letters dated December 14, 1992, and December 17, 1992," dated July 10, 1998.

2. Letter, Huffman to McIntyre, "Request for withholding information from public disclosure of Westinghouse AP600 design letters of December 15, 1992," dated July 14, 1998.

3. Letter, Sebrosky to McIntyre, "Request for withholding information from public disclosure for Westinghouse AP600 design letter of February 24, 1993, April 19, 1993, and July 14, 1993," dated June 18, 1998.

4. Letter, McIntyre to Quay, "Status review of AP600 proprietary submittals," dated September 18, 1995.

Dear Mr. Quay:

Reference 1 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated December 14, 1992, that provided the NRC with copies of presentation material from a management meeting held December 14, 1992, discussing the AP600 testing program. The NRC has no record of a nonproprietary version of the slides being provided. At the time this presentation was made, the information was proprietary since that description of the AP600 testing program had commercial value to Westinghouse. At this time, almost six years later, this information does not have commercial value and is no longer considered to be proprietary by Westinghouse.

Reference 1 also provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated December 17, 1992, that provided the NRC with copies of presentation material from a meeting with the technical staff held December 9-10, 1992, discussing the AP600

3787a.wpf

9808200180

3pp

(Enclosure 2)

testing program. The NRC has no record of a nonproprietary version of the slides being provided. At the time this presentation was made, the information was proprietary since that description of the AP600 testing program had commercial value to Westinghouse. At this time, almost six years later, this information does not have commercial value and is no longer considered to be proprietary by Westinghouse.

Reference 2 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated December 15, 1992, that contained a preliminary description of the AP600 refueling outage plan activities. The NRC assessment was that no material in the letter was specifically identified as being proprietary and that a nonproprietary version was not provided. At the time this subject was being discussed with the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. At this time, almost six years later, this information does not have commercial value and is no longer considered to be proprietary by Westinghouse.

Reference 3 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated February 24, 1993, that contained presentation materials from the February 24, 1993, Westinghouse/NRC AP600 senior management meeting. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 probabilistic risk assessment and AP600 standard safety analysis report. In addition the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. Our 1995 request, Reference 4, indicated that the material provided in the Westinghouse letter of February 24, 1993, was presentation material that was intended for clarification only, not part of the formal review material and requested that the material be returned to Westinghouse. At the time this subject was being discussed with the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If this presentation material was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, over five years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 3 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated April 19, 1993, that contained presentation materials from the April 20, 1993, AP600 overview. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 probabilistic risk assessment and AP600 standard safety analysis report. In addition the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. Our 1995 request, Reference 4, indicated that the material provided in the Westinghouse letter of April 19, 1993, was presentation material that was intended for clarification only, not part of the formal review material and requested that the material be returned to Westinghouse. At the time this subject was being discussed with the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If this presentation material was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, over five years later, this information is no longer considered to be proprietary by Westinghouse.

Reference 3 provided the NRC assessment of the Westinghouse claim that proprietary information was provided in a letter dated July 14, 1993, that contained presentation materials from the July 14, 1993, meeting where the AP600 main control room habitability was discussed. The NRC assessment was that the material was similar to material that exists in the current (1998) nonproprietary version of the AP600 probabilistic risk assessment and AP600 standard safety analysis report. In addition the staff indicated the material was used by the staff in the development of the AP600 draft safety evaluation report and therefore should remain on the docket. Our 1995 request, Reference 4, indicated that the material provided in the Westinghouse letter of July 14, 1993, was presentation material that was intended for clarification only, not part of the formal review material and requested that the material be returned to Westinghouse. At the time this subject was being discussed with the NRC technical staff, the information was considered to be proprietary by Westinghouse since it contained information that had commercial value to Westinghouse. If this presentation material was indeed used by the staff in development of the AP600 draft final safety evaluation report in November 30, 1994, then at this time, over five years later, this information is no longer considered to be proprietary by Westinghouse.

This response addresses the proprietary issues delineated in the references.

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

jml

cc: J. W. Roe - NRC/NRR/DRPM
J. M. Sebrosky - NRC/NRR/DRPM
W. C. Huffman - NRC/NRR/DRPM
H. A. Sepp - Westinghouse