ATTACHMENT 7

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SAFETY EVALUATION FOR THE INSTALLATION OF STABILIZERS ON THE EDWIN I. HATCH NUCLEAR PLANT UNIT 2 CORE SHROUD

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INSTALLATION OF STABILIZERS ON
THE EDWIN I. HATCH NUCLEAR PLANT UNIT 2
CORE SHROUD

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IMPORTANT NOTICE REGARDING

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1.0 DESCRIPTION OF CHANGE

Due to concern for potential cracking of the core shroud, a preemptive replacement of the shroud horizontal welds will be installed in the Edwin I. Hatch Nuclear Plant Unit 2.

1.1 General

Welds H1 through H8 of the core shroud will be structurally replaced by a set of four stabilizer assemblies. Figure 1 shows a stabilizer assembly. Each stabilizer attaches to the top at the shroud flange and to the shroud support at the bottom.

Radially acting stabilizers are used to maintain the alignment of the core shroud to the reactor pressure vessel (RPV) during seismic loading. The set of stabilizers replace the structural functions of the shroud welds which are postulated to contain cracks. Each stabilizer assembly consists of a tie rod, two upper stabilizers, a lower spring, an upper bracket, a mid span tie rod support, a lower collet, and other minor parts. The tie rod provides the vertical load carrying capability from the upper bracket to the shroud support collet attachment as well as providing support for the radial springs. The vertical locations of the radial springs were chosen to provide the maximum support for the shroud and fuel assemblies. The upper spring provides radial load carrying capability from the shroud, at the top guide elevation, to the RPV. The lower spring provides radial load carrying capability from the shroud, at the core support plate elevation, to the RPV. The upper bracket provides an attachment feature for the assembly to the top of the shroud as well as providing restraint for the upper shroud welds. The mid span tie rod support provides a limit stop for the shroud cylinder between H4 and H5 as well as provides a support for the tie rod which increases the natural frequencies of the tie rod.

There are 9 horizontal welds (see Figure 2) in the Hatch 2 shroud. These welds are titled H1 - H8 with the welds at the core support elevation titled H6A and H6B. H1 is the uppermost and H8 is the attachment of the shroud support cylinder to the shroud support plate. Each cylindrical section of the shroud is prevented from unacceptable motion by the stabilizers even if it is assumed that its respective welds contain 360 degree through wall cracks. The motion of the sections above H1, between H1 and H2, and between H2 and H3 are restrained by the upper bracket. The upper bracket contacts the shroud and is radially restrained by the upper stabilizer which contacts the RPV. There is also a feature on the upper bracket which prevents unacceptable motion of the section between H3 and H4. The section between H4 and H5 is prevented from unacceptable motion by a limit stop which is part of the tie rod mid support. The lower spring contacts the shroud such that it prevents unacceptable motion of the sections between H5 and H6A. There is an extension on the lower spring which prevents unacceptable motion of the section between H6A and H6B as well as the section between H6B and H7. The section between H7 and H8 is prevented from unacceptable motion by a limit stop which is part of the collet assembly.

The significant forces applied to the stabilizers are from seismic, loss of coolant accident (LOCA) and thermal expansion. The stabilizer assemblies and potential cracks in the shroud change the seismic response of the reactor internals. Thus it was necessary to modify the seismic analysis of the reactor to include the cracks and the stabilizer assemblies. This dynamic analysis was performed in an iterative manner to determine the appropriate values of the spring constants of the upper and lower springs as well as the number of stabilizer assemblies. The final number of assemblies required was determined to be four. Each assembly has an upper stabilizer assembly with a rate constant of 3800 kips per inch and a lower spring with a rate constant of 1500 kips per inch. A wedge between the core support plate and the shroud is also required at each stabilizer location to prevent relative motion of the core plate to the shroud. The limit stop at the middle of the tie rod not only limits the motion of the shell between H4 and H5, but also increases the natural frequency of the rod to prevent unacceptable vibration.

1.2 Design

Significant cracking adjacent to the horizontal shroud welds has been observed at several BWRs. Based on this knowledge, and to minimize the consequences of postulated future cracking at the Edwin I. Hatch Nuclear Plant Unit 2, a preemptive shroud repair will be implemented. The replacement will structurally replace all of the horizontal girth welds in the shroud with a set of four stabilizers.

The core shroud is a safety related component. It also provides horizontal support for the fuel assemblies, control rods, and incore instrumentation. Finally it provides vertical support for the top guide, and core support plate. It also provides a floodable volume inside the reactor pressure vessel (RPV) and it supports the core spray spargers and core spray lines.

Weld H1 does not provide a safety related function and welds H1 through H4 are above the floodable volume.

The stabilizers were designed to the structural criteria specified in the current Edwin I. Hatch Nuclear Plant Unit 2 UFSAR. The stabilizers were designed to the requirements of References 6.1 and 6.2. Reference 6.1 is the design specification for the stabilizers, exclusive of ASME Code aspects. Reference 6.2 contains the ASME Code requirements. Both design specifications apply to the stabilizers. All of the loads and load combinations specified in the UFSAR, that are relevant to the core shroud, are included in the design specifications. In addition, the 1/2 Seismic Margin Earthquake (1/2 SME) was included in the design specifications. The increased operating pressure differentials due to increased core flow are included in the design specifications and have been considered in the design of the stabilizers. Power uprate conditions are included in the design requirements of References 6.1 and 6.2.

The stabilizers are installed with a small vertical preload, which assures that all components are tight after installation and during cold shutdown, and provides approximately 3500 pounds of axial load on the 3.75 inch diameter tie rods. The upper bracket, upper stabilizers, lower spring, and collet are fabricated from Inconel alloy X-750. The tie rod is fabricated from type XM-19 stainless steel. The spring, bracket, and tie rod materials have a smaller coefficient of thermal expansion than does the 304L shroud. Thus the stabilizer assemblies are thermally preloaded when the reactor is at operating conditions. The spring constant of the stabilizers in the vertical direction was designed to provide a total vertical preload at operating conditions which is greater than the net upward applied loads on the shroud. Thus, if a combination of, or all of welds H1 through H8 were completely cracked, the stabilizers will vertically restrain the shroud such that no displacement will occur during normal operation, which minimizes potential leakage through the cracks.

The vertical location of the upper and lower springs were chosen to provide the maximum horizontal support for the fuel assemblies assuming that the shroud contained cracks. The upper springs are at the top guide elevation and the lower springs are at the core support plate elevation. All of the horizontal support for the fuel assemblies is provided by the top guide and the core support plate.

The stabilizer assemblies are designed and fabricated as safety related components. The installation of the stabilizer assemblies structurally replaces the functions of welds H1 through H8.

At the top, each stabilizer assembly fits into a pair of slots, which is machined partially into the top shroud flange just below the shroud head. The stabilizer upper bracket is inserted into these slots in the shroud top flange. It then extends downward to below weld H3. It supports the upper stabilizers and has a hole through which the tie rod passes. The tie rod is held against the upper bracket with a nut. The tie rod extends downward approximately 151 inches to the lower spring. At the middle of the tie rod there is a support between the tie rod and the RPV. The support is installed such that there is a force between the tie rod and the RPV. The support serves two functions. The first function is that it provides a support for the tie rod, to minimize the potential for vibration, and the second function is that it provides a limit to the potential motion of the shroud between H4 and H5. At the bottom, the tie rod threads into the lower spring. The lower spring has a clevis at its bottom, which is attached to a collet connector with a pin. The collet connects to the shroud support through a 4.2 inch hole which is machined in the shroud support.

All pieces of the stabilizer assemblies are locked in place with mechanical devices. Loose pieces can not occur without the failure of a locking device. The stresses in the stabilizer components during normal plant operation are less than one third of the normal event allowable stresses. The stabilizers are fabricated from stress corrosion resistant material. Therefore, it is unlikely that a stabilizer component will fail. However, if one stabilizer is postulated to fail during normal plant operation, there would be no consequence to the shroud (even if it is cracked) or to the other three stabilizers. The leakage through a cracked shroud may increase slightly, but it would not be detectable. The plant would continue to operate until the next refueling outage, when the broken stabilizer would most likely be detected and repaired. The postulated broken component may fall to the shroud support plate or may be sucked into the recirculation pump. The consequences of the postulated loose stabilizer piece would be consistent with the consequence of other postulated loose pieces.

The fast flux levels at the stabilizers are low compared to the values which could degrade material properties. Even after 20 years of operation the maximum fast fluence at the stabilizers will be approximately 2E19, which is well below the value to cause damage to stainless steel.

1.3 Materials

The stabilizers are fabricated entirely from the type 316 stainless steel, type XM-19 stainless steel and alloy X-750. There is no welding required during fabrication or installation.

The upper stabilizers, lower spring, upper nut, upper bracket, and collet are fabricated from Alloy X-750 (Ni-Cr-Fe) material that has been heat treated at 1975 ± 25°F followed by an air cool and age hardened after machining to increase its strength. The annealing and age hardening processes used are the same as those used on the improved jet pump beams. As an IGA control, a minimum of 0.030 inches of material is removed after the last exposure to acid pickling or high temperature annealing. This material is certified to ASTM B637, Grade UNS N07750. Alloy X750 was chosen because its inherent high strength was required and because its coefficient of thermal expansion is less than that of the shroud. Alloy X750 is resistant to IGSCC at the stress levels the components will experience during operation, which is even less stress than the jet pump beams experience.

The tie rods are fabricated from type XM-19 stainless steel material with a carbon content less than 0.040%. The material was annealed at 1950 to 1975 degrees F followed by air cooling to a temperature below 800 degrees F within 20 minutes of removal from the furnace.

The other components are fabricated from type 316 stainless steel material with a carbon content less than 0.02%. The material was annealed at 1900 to 2100 degrees F followed by quenching in circulating water to a temperature below 400 degrees F, or an equivalent procedure. All material was tested for evidence of sensitization.

1.4 System Evaluation

The hardware designed to repair the shroud with identified cracks for Hatch 2 requires the machining of four holes through the shroud support plate and eight pockets in the shroud head flange. Each of the holes in the shroud support plate will have some clearance, which will allow leakage flow to bypass the core and the steam separation system. The pockets in the shroud head flange are sufficiently shallow so that there is no leakage from the upper core plenum to the vessel downcomer region. Additional leakage may occur through the weld cracks (H1 through H8) and the replacement access hole cover. The leakage flows and their performance impact were evaluated for 100% uprated power (corresponding to 105% rated power, 2558 MWt) and 87 to 105% rated core flow.

1.4.1 Leakage Flow Evaluation

Installation of the shroud repair mechanism requires the machining of 4 holes through the shroud support plate. A collet assembly is installed through each hole to anchor tie rods installed as part of the repair. The leakage flow areas are based on the clearances of the collet assembly parts passing through the shroud support plate. In addition, there are a total of 9 circumferential shroud welds (H1 - H8) that are considered as potential leakage paths - 2 above the top guide support ring, 4 on the upper shroud between the core support ring and the top guide support ring, and 3 between the core support ring and the shroud support plate. It is conservatively assumed that each of these welds develops a complete circumferential crack that opens to 0.001 inches.

The leakage flows for 100% uprated power and 105% rated core flow [increased core flow (ICF)] are summarized in Table 1. These leakage flows are based on applicable loss coefficients and reactor internal pressure differences (RIPDs) across the applicable shroud components. Leakage from the weld cracks above the top guide support ring is assumed to be two-phase fluid at the core exit quality. Leakage from the remaining paths below the top guide support ring is considered single-phase liquid. All of the leakage flows bypass the steam separators and dryers. The leakage flows below the core support ring also bypass the core. The results show that the leakage flows from the repair holes, weld cracks and the access hole cover result in a combined leakage of about 0.22 % of core flow at 100% uprated power and 87 to 105% rated core flow.

Table 1. Summary of Leakage Flows at Uprated Power and ICF

Leakage flow (gpm)	
Weld cracks	130
Repair holes in support plate	185
Access hole covers	185
Leakage-to-core mass flow (%)	
Weld cracks	0.045
Repair holes in support plate	0.085
Access hole covers	0.085

The steam portion of the leakage flow will combine with the carryunder from the steam separators, resulting in increased total carryunder in the vessel downcomer region. The impacts of the total leakage on the steam separation system performance, jet pump performance, core monitoring, fuel thermal margin, emergency core cooling system (ECCS) performance and fuel cycle length are evaluated as summarized in the following subsections.

1.4.2 Steam Separation System

The leakage flow through weld cracks H1 and H2 occurs above the top guide support ring and includes steam flow, which slightly increases the total carryunder in the downcomer by about 0.001% at rated power. The total leakage flow also has the effect of slightly decreasing the flow per separator and slightly increasing the separator inlet quality. The separator performance is based on the applicable separator test data over the operating water level range. The combined effective carryunder from the separators and the shroud leakage is at uprated power and 87 to 105% rated core flow and is bounded by the design value (0.25 wt %). The carryover from the separators remains within the design limits so that moisture from the dryer meets the plant performance requirement of less than 0.1%.

1.4.3 Jet Pumps

The increased total carryunder will decrease the subcooling of the flow in the downcomer. This in turn reduces the margin to jet pump cavitation. However, because the total carryunder meets the design-condition carryunder value, there is no impact on jet pump performance compared with the design condition.

1.4.4 Core Monitoring

The impact of the leakage results in an overprediction of core flow by about 0.19% of core flow. This overprediction is small compared with the core flow measurement uncertainty of 2.5% for jet pump plants used in the MCPR Safety Limit evaluations. Additionally, the decrease in core flow resulting from the overprediction results in only about 0.1% decrease in calculated MCPR. Therefore, it is concluded that the impact is not significant.

1.4.5 Anticipated Abnormal Transients

The code used to evaluate performance under anticipated abnormal transients and determine fuel thermal margin includes carryunder as one of the inputs. The effect of the increased carryunder due to leakage results in greater compressibility of the downcomer region and, hence, a reduced maximum vessel pressure. Since this is a favorable effect the thermal limits are not impacted.

1.4.6 Emergency Core Cooling System

Leakage through weld cracks H1 and H2 results in slightly increased carryunder that causes the initial core inlet enthalpy to increase slightly, with a corresponding decrease in the core inlet subcooling. Another effect of the leakage flows from the repair holes and the weld cracks is to decrease the time to core uncovery slightly and, also, to increase the time to core recovery. The combined effect has been conservatively assessed to increase the peak cladding temperature (PCT) for the limiting loss-of-coolant accident (LOCA) by less than 10°F. The current analysis basis yields a LOCA licensing PCT of 1526°F for the recirculation suction line break LOCA with battery failure (limiting LOCA event). The impact of power uprate on the PCT is less than 20°F. The 10CFR50.46 regulatory limit PCT is 2200°F. Because the maximum potential effect on the design basis LOCA PCT is very small, there is no adverse effect on the margin of safety. This impact is sufficiently small to be judged insignificant, and, hence, the licensing basis PCT for the normal condition with no shroud leakage is applicable. The sequence of events remains essentially unchanged for the LOCA events with the shroud repair leakage.

1.4.7 Fuel Cycle Length

The increased carryunder due to leakage flow above the top guide support ring results in a slight increase in the core inlet enthalpy, compared with the no-leakage condition. The combined impact of the reduced core inlet subcooling and the reduced core flow due to the leakage results in a minor effect (~0.5 days) on fuel cycle length and is considered negligible.

1.4.8 Conclusions

The impacts of the leakage flows through the shroud repair holes and the potential weld cracks in the shroud have been evaluated. The results show that at uprated power and 87 to 105% rated core flow the leakage flow from the shroud repair holes, weld cracks and replacement access hole covers is predicted equal to a combined leakage of about 0.22% of core flow. This leakage flow is sufficiently small so that the steam separation system performance, jet pump performance, core monitoring, fuel thermal margin and fuel cycle length remain adequate. Also, the impact on ECCS performance is sufficiently small to be judged insignificant, and, hence, the licensing basis PCT for the normal condition with no shroud leakage is applicable.

1.5 Seismic Analysis

A seismic analysis of the Edwin I. Hatch Nuclear Plant Unit 2 has been performed to obtain shroud repair design loads as well as loads in selected NSSS components to support the shroud repair project. These loads were used for the new stabilizer hardware design as well as to validate the integrity of the reactor vessel internal structures and to ensure emergency shut-down. Analyses were completed for a range of postulated shroud weld cracks as well as for a fully uncracked configuration with shroud restraint hardware installed.

The seismic mathematical model for analysis was generated based on the information provided by SNOC for the building model, and by Reference 6.4 for the reactor and internals, consistent with the models identified in the UFSAR (Reference 6.3). With the exception of the stabilizer hardware for the repair, the updated core properties, and the provisions for crack modeling, the model used was identical to the original model. Three models were created for each of the E-W, N-S and vertical directions. In order to benchmark the new analytical results against those previously reported, the mode and frequency analysis with an integral uncracked shroud without the shroud repair was carried out for the E-W model. Good agreement in the eigenvalue data set was achieved with values identified in Reference 6.4. Further, building in-structure response spectra (IRS) were generated and compared to baseline IRS, also with good agreement.

Computer program SAP4G07 (Reference 6.6) was used in this study. Transient response analysis with modal superposition method was adapted and a solution time step of .0025 second was chosen according to the user's manual for this linear analysis. Analyses were performed for N-S, E-W and vertical directions.

Vertical seismic effect is combined linearly with the horizontal seismic load (either North-South or East-West.

The spring rates for the stabilizer supports and tie-rods are included in the analysis. Radial springs were used at both the top guide plate and the core support level to model the upper stabilizers and lower spring. The spring constant for the tie-rods was calculated based on the four tie-rods' rotational stiffness.

An enveloping combination of cracked/uncracked welds has been analyzed to define the worst case combination for the core plate and top guide displacements. The stabilizer design is based on the worst case scenario to insure control rod insertion and safe shut-down, should this postulated scenario occur. Each cracked weld was postulated to have a 360 degree through wall crack. It was concluded that five cracked cases bound the numerous possible combinations of assumed cracked welds while considering the various plant operating conditions, and yielding the maximum spring loads for the shroud repair hardware. The five bounding cases are:

All welds cracked	-	weld H1 modeled as a roller, H2 through H8 modeled as hinges.
Weld H4 cracked	-	H4 modeled as a hinge.
Weld H4 cracked	-	H4 modeled as a roller.
Weld H8 cracked	-	H8 modeled as a hinge.
Weld H8 cracked	-	H8 modeled as a roller.

OBE, DBE and 1/2 SME analyses were performed independently. The loading and deflections considered for the repair design bound the results of all crack configurations.

The maximum deflection of any part of the shroud that is not directly supported by either the upper or lower radial springs is limited to approximately 0.75 inch by mechanical limit stops. These stops do not perform any function unless a section of the shroud, for example between H4 and H5, becomes loose and a combined LOCA plus seismic event occurs. If this unlikely scenario occurs, the stops will limit the horizontal displacement to approximately 0.75 inch, which is equal to one half of the shroud wall thickness. These stops do not invalidate the linear seismic analysis because very little mass is associated with any potential loose and unsupported section of the shroud. A displacement equal to one half of the shroud wall thickness will not result in post event leakage that prevents core cooling, because the shroud sections still overlap each other by one half (0.75 inch) of the shroud wall thickness.

In order to insure that the installation of the stabilizer design does not adversely affect the existing dynamic qualification of the RPV and internals, assuming no defective welds are present, analyses for the uncracked case were performed with and without the shroud repair in place. It was concluded that seismic loads in the RPV and internal structures are decreased, or at least not significantly increased, by the shroud stabilizer installation. It was also shown that loads in the RPV and internals are further reduced by the inclusion of the most limiting combination of assumed cracks. This is due to the fact that as the shroud rigidity is decreased the fuel is isolated, and the seismic load is mainly carried by the stabilizer springs and the tie-rods.

1.6 Design Evaluation

The results of the structural evaluations per References 6.1 and 6.2 are documented in References 6.7 and 6.8. Reference 6.7 addresses the ASME Section III RPV and Reference 6.8 addresses the stabilizers and the non code affected components. The stabilizers and affected shroud and RPV components are shown to satisfy the UFSAR structural requirements using the UFSAR load combinations. The displacements of the core support plate and the top guide are limited to the allowable displacements given in Reference 6.1, for all load combinations.

1.6.1 Load Combinations

The FSAR requires evaluation of normal operating loads as well as OBE, SSE, main steam line LOCA, and recirculation line LOCA. In addition, the 1/2 SME earthquake is also evaluated. The following load combination and their classification were considered:

Normal:	Weight, normal operating pressure differences and temperatures
Upset 1:	Weight, normal operating pressures and temperature plus OBE
Upset 2:	Limiting thermal condition, which is caused by a scram with a loss of feedwater pumps plus normal operating weight and pressure differences
Emergency 1:	Weight plus normal operating pressures plus DBE
Emergency 2:	Weight plus main steam line LOCA
Emergency 3:	Weight plus normal operating pressures plus 1/2 SME
Faulted 1:	Weight plus DBE plus main steam line LOCA
Faulted 2:	Weight plus DBE plus recirculation line LOCA
Faulted 3:	Weight plus 1/2 SME plus main steam line LOCA
Faulted 4:	Weight plus 1/2 SME plus recirculation line LOCA

Other upset conditions were considered, such as loss of feedwater heaters, but are bounded by the Upset 1 and Upset 2 cases above.

The values of the individual loads were obtained from the design specifications and the seismic report (References 6.1, 6.2 and 6.5), which include the seismic analysis results of the shroud with postulated horizontal weld cracks and with the stabilizers assemblies installed.

Each of the horizontal weld cracks are modeled as either hinges or rollers. The seismic results for the roller cases are used for the stress analysis only when it is found that the mechanical and thermal preload is exceeded on all four tie rods simultaneously. If the applied uplift loads result in a tension load applied to each tie rod that exceeds the preload, then the compressive load on the shroud is fully relieved allowing the crack to fully separate. This condition only occurs for load combinations which include the main steam line LOCA. When the applied uplift loads are less than the preload, the shroud crack surfaces remain in contact which allows the jagged IGSCC crack to transmit shear. This condition is modelled as a hinge in combination with horizontal seismic loading. During normal operation the crack surfaces are held fully in contact by the tie rods.

The limiting loads in the tie rods, upper stabilizers, and lower springs occur with different assumed shroud cracks. The limiting loads in the tie rods occur when it is assumed that there is a 360 degree through wall crack in weld H4. The limiting loads in the radial direction on the upper stabilizers occur when it is assumed there is a 360 degree through wall crack in weld H8. The limiting loads in the radial direction on the lower springs occur for the all-welds-cracked case.

An evaluation of the effects of shroud stiffness on tie rod preload is documented in reference 6.8. The lowest tie rod thermal preload occurs when the tie rods are installed on the uncracked shroud and subsequently shroud welds including H2, H3 and H6B crack. The lowest resulting tie rod preload was still found to provide a net compression on the shroud. Therefore, no crack separation will occur during normal operation.

1.6.2 Results

The potential for flow induced vibration has been evaluated by calculating the lowest natural frequency of the tie rods and the highest vortex shedding frequency due to the water in the downcomer. The lowest natural frequency is 69 Hertz and the maximum vortex shedding frequency is 4.4 Hertz. This combination satisfies the standard GE design goal of a factor of three between excitation frequency and lowest natural frequency.

There will be essentially no fatigue of any of the stabilizer components.

References 6.7 and 6.8 document that all structural limits are satisfied. The predicted worst case (smallest margin) transient deflections of the core plate is 0.24 inches for a load combination of a DBE assuming all welds cracked. The allowable transient displacement for this emergency event is 1.12 inches. All predicted stress intensities in the lower radial spring meet the UFSAR allowables. The predicted worst case transient displacement of the top guide is 0.23 inches for a DBE plus main steam line LOCA assuming weld H8 is cracked acting as a roller. The allowable transient deflection of the top guide for this faulted event is 4.0 inches. The stresses in the upper radial stabilizers meet the UFSAR allowables. Neither the upper nor the lower springs will have a permanent deformation after a DBE emergency event. Further, the maximum transient deflections are far less than even the allowable permanent deformations which are 1.4 inches in the upper spring and 0.5 inch in the lower spring for emergency, or 1.87 inches and 0.67 inch respectively for the faulted combination. The predicted deflections of both the top guide and the core plate, for all load combinations, are well within the allowables defined in the design specification; derived from testing (Reference 6.10).

The shroud repair hardware was designed to a minimum 0.25 design margin ((allowable/actual) - 1) for all load combinations with two exceptions. The lower spring and upper support achieves this minimum design margin in all instances except for the bounding axial load during a DBE plus main steam line LOCA (assuming both the bounding DBE and bounding LOCA loads occur simultaneously) where the design margin in the lower spring is 0.11 and in the upper support is 0.16. This approach was pursued at the request of SNOC and is not necessitated by any other requirement.

1.7 Installation Concerns

1.7.1 Potential Debris Generated By Installation Processes

The stabilizer installation involves the following operations that could generate small objects or debris that may remain in the reactor after the repair is completed.

- Electrical Discharge Machining (EDM) generates swarf which is very fine particles comprised of carbon, nickel, iron, chromium, etc. (the elements contained in the EDM electrode and the shroud and shroud support material). These particles are very small (approximately 1-50 microns). Greater than 95% of the swarf generated is collected by the EDM electrode flushing system. However, when the EDM electrode breaks through the shroud support, the flushing system cannot collect the swarf. This swarf would remain in the reactor; but is a very small amount of swarf, less than a tenth of a percent of the total generated swarf, and is viewed as insignificant.

The minute sand-like particles from the EDM process are too fine and small to be caught at one of the fuel spacers. Most likely, these particles will be carried by the cooling flow up through the length of fuel bundles and then be discharged from the reactor core through the top of the upper tie plate. They will eventually be removed from the reactor coolant by the reactor water cleanup (RWCU) system. Therefore, there is no potential for fuel fretting due to the EDM process.

The potential for the particles generated by the repair processes causing CRD seal wear was also evaluated. Because the particles generated are so small, they will most likely be carried by the cooling flow up through the length of fuel bundles and then be discharged from the reactor core through the top of the upper tie plate or by the core bypass flow through the core region and then be discharged through the top guide. They will eventually be removed from the reactor coolant by the reactor water cleanup (RWCU) system. The upward flow direction makes it highly unlikely that these particles will be deposited on the top of the core plate so that they can migrate to the bottom of the control rod guide tubes where they could be sucked into the CRD. Therefore, it is very unlikely that these particles will have any significant effect on CRD seal wear or adverse effects on CRD operation.

In addition to the CRD seals, the potential for the particles generated by the repair processes adversely affecting the reactor recirculation pump seal performance or life was evaluated.

Ideally, the reactor recirculation pump seals should be operated in a clean, and air free environment. This objective is achieved by venting the seals after maintenance and purging the seals during operation. Seal purge injects 2 GPM of clean water into the seal cartridge to keep solids such as reactor corrosion products, or in this case the EDM by-products from reaching the critical components of the seal.

The debris generated by the EDM during the shroud modification should not impact the seal function and life for the following reasons:

1 The amount of material released by the EDM process is very small when compared to the corrosion byproducts that are routinely released by the reactor

and the carbon steel piping. In other words, the shroud stabilizer installation would only slightly aggravate the normal cleanliness of the reactor water, not overwhelm the reactor cleanup system capacity.

2 The solids that are generated by the EDM process are not as abrasive as the normal reactor corrosion products (iron oxide).

3 The sites of the EDM are relatively far from the pump seals. The debris will primarily be picked up by the cleanup system. Some debris may eventually reach the pump casing; however, the seal purge will prevent entry into the seal cavity.

4 The site venting and purging procedures with the recommendations below will appropriately protect the seals against debris generated by the shroud stabilizer installation. It is recommended that all venting be performed in two stages: 1) prior to pump startup, 2) after 3-10 minutes of pump operation, vent again. This allows the residual trapped air to be discharged.

Therefore, it is believed that the shroud stabilizer installation will not adversely affect the reactor recirculation pump seal performance or life.

The potential for the particles generated by the installation processes having adverse effects on instrumentation was also reviewed. Because the remaining particles are expected to be dispersed by the flow throughout the reactor and there is no flow through the instrumentation that would tend to draw in these particles, it is not expected that these particles would be able to migrate into the instrumentation lines in sufficient quantities to cause plugging or other adverse effects. Therefore, it is very unlikely that these particles will have any significant effect on the instrumentation.

In summary, the EDM particles and the metal particles generated by the installation of the shroud stabilizers do not represent a concern for fuel fretting and subsequent fuel damage nor do they represent a concern for CRD seal wear, reactor recirculation pump seal life, or adverse effects on instrumentation. Field experience from previous repairs has not identified any operational problems due to the particles generated by the installation processes. In the unlikely event that any abnormal results should occur from an EDM process, they will be addressed by a separate evaluation at the time they occur.

Four holes will be machined into the shroud support for attachment of the shroud repair hardware, each 90 degrees apart. These holes will be drilled using a Trepan style drill, specifically developed and thoroughly tested for this application, to within 3/4 inches of the underside of the shroud support. The drilling process produces marble sized nodules of shroud support material which are captured by a suction system integrated as part of the drilling tool. The drilling process will be monitored by remote camera. In the unlikely event that a nodule was not captured, the nodule would come to rest on the shroud support. This area will be inspected with the remote camera and vacuumed with suction equipment to assure complete capture of drilling particles. Complete capture of drilling particles is thus assured.

Each of the four holes is completed by EDM. Capture of the core is assured by a hydraulic collet style clamp on the inside of the EDM actuator. EDM core capture by this method has been proven reliable in past applications. In the unlikely event that the approximately 25 pound hole core were to get loose before it was extracted from the hole, it would simply drop to the bottom of the RPV, from where it would then be retrieved.

1.7.2 Control Of Parts And Tooling During The Installation

Parts and tooling are logged and controlled per plant tool control procedures prior to installation in the vessel. Tooling is checked for loose parts prior to installation and verified still intact upon removal. Jet pump covers are being installed as needed to prevent the possibility of introduction of loose parts entering the jet pumps if anything was inadvertently dropped. Fuel cell covers are being installed over any fuel support casting in the work area. Protective covers are being installed on the core spray and feedwater spargers to prevent any accidental contact.

1.7.3 Protection Of Plant Components During Installation

A dynamometer is used whenever any heavy item is installed or removed from the vessel to take the place of safety kinking the cables. Personnel have been trained on the installation techniques necessary to protect delicate items, such as jet pump sensing lines, during full scale mockup training. All lifting and handling equipment has been designed in accordance with NUREG-0612 requirements for Special Lifting Devices and have been load tested to 300% of the loads being lifted. Certifications are maintained in the Project Quality Assurance file.

2.0 REASON FOR CHANGE

Cracks have been observed in the core shrouds of several BWRs. The NRC has issued a generic letter, Reference 6.9, which required inspection or repair. A preemptive installation of stabilizers was chosen for Edwin I. Hatch Nuclear Plant Unit 2. This Safety Evaluation discusses the preemptive installation of the stabilizers. The stabilizers structurally replace welds H1 through H8 in the Hatch Unit 2 shroud. This Safety Evaluation is based on the assumption that all of the horizontal girth welds (H1-H8) have significant cracking. However, as stated earlier, there is no degradation of function if the stabilizers are installed in the absence of cracks.

3.0 DESIGN AND LICENSING DOCUMENTATION REVIEW

The Hatch Unit 2 UFSAR (Reference 6.3) was reviewed. The results of that review are as follows. The numbers in ( ) are the paragraph numbers from which the information was extracted.

(4.2.2.2.1)	Gives a brief description of the shroud
(Table 4.2-20)	Defines the pressure differences across the reactor internals.
(Table 3.7B-1)	Defines the damping values to be used in seismic analysis.
(4.2.2.1.2.2 & Table 4.2-19)	Defines the required load combinations and required safety factors.
(Tables 4.2-11 & 4.2-12)	Define the allowable deflections and stresses.
(Table 3.9-10)	States that ASME Section VIII was used as a guide.

4.0 ANSWERS TO THE APPLICABILITY DETERMINATION CRITERIA

Does the procedure, design change, modification, test or experiment, to which this evaluation is applicable, represent:

4.1 Yes _X_ No ___ A change to the plant as described in the FSAR?
FSAR Paragraph 3.3.4.1.1 states that the shroud is welded to the shroud support. That sentence should be changed. The stabilizers should also be described.

4.2 Yes ___ No _X_ A change to procedures as described in the FSAR?
The installation of stabilizers does not involve any procedures described in the FSAR.

4.3 Yes ___ No _X_ A test or experiment not described in the FSAR?
The installation of stabilizers does not involve any test or experiment described in the FSAR.

4.4 Yes _X_ No ___ A new structure, system, component, procedure, test or experiment, which could impact the safety of operations or affect nuclear safety in a way not previously evaluated in the SAR?
The stabilizers are new safety related components which have not

been evaluated in the FSAR.

4.5 Yes ___ No _X_ A change to the existing situation, but is not covered by Questions 4.1 – 4.4, which could impact the safety of operations or affect nuclear safety in a way not previously evaluated in the SAR?

4.6 Yes ___ No _X_ A change that is already bounded by a valid and approved 10CFR 50.59 safety evaluation?

4.7 Yes ___ No _X_ A change to the Technical Specifications as incorporated in the operating license?

4.8 Yes _X_ No ___ Will an USAR update be required? ("Yes", if 4.1, 4.2 or 4.3 is "Yes", or may be "Yes", if only 4.4 or 4.5 is "Yes". But always "No" for a temporary change.)

4.9 Yes _X_ No ___ Is a safety evaluation (USQD) required? ("Yes", if 4.1, 4.2, 4.3, 4.4 or 4.5 is "Yes" and 4.6 is "No". But always "No", if 4.6 or 4.7 is "Yes".)

4.10 Yes ___ No _X_ Will a Tech Spec change be required? ("Yes", if 4.7 is "Yes".)

5.0 UNREVIEWED SAFETY QUESTION CRITERIA

5.1 Yes ___ No _X_ May the proposed activity increase the probability of an occurrence of an accident previously evaluated in the FSAR?
The installation of stabilizers does not change the probability of any accident evaluated in the FSAR.

5.2 Yes ___ No _X_ May the proposed activity increase the consequence of an accident previously evaluated in the FSAR?
The installation of stabilizers does not increases the consequence of any accident evaluated in the FSAR. The stabilizers assure that the shroud, even if cracked, will perform its safety functions.

5.3 Y ___ N _X_ May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the FSAR?
The installation of stabilizers will not increase the probability of malfunction of equipment important to safety. The stabilizers are designed and constructed as safety related components.

5.4 Yes ___ No _X_ May the proposed activity increase the consequences of a malfunction of equipment important to safety previously

evaluated in the FSAR?
The installation of stabilizers assure that the shroud, even if cracked, will perform its safety functions. Thus, consequences of a malfunction of equipment important to safety is not increased.

5.5 Yes ___ No __X__ May the proposed activity create the possibility of an accident of a different type than previously evaluated in the FSAR?
The stabilizers were designed such that they meet all of the applicable FSAR criteria.

5.6 Yes ___ No __X__ May the proposed activity create the possibility of a malfunction of equipment important to safety of a different type than previously evaluated in the FSAR?
The stabilizers structurally replace the shroud horizontal welds. The stabilizers are fabricated from stress corrosion resistant material and have low applied stresses during normal operation. There is no welding in the construction or installation of the stabilizers. A single failure of a stabilizer is highly unlikely. Even if it occurred, the failure would not lead to the malfunction of other safety related equipment.

6.0 REFERENCES

6.1 25A5718 Rev. 0 "Shroud Repair Hardware" (Design Specification).

6.2 25A5717 Rev. 1 "Shroud Stabilizers" (Code Design Specification).

6.3 Edwin I. Hatch Nuclear Plant Unit 2, Updated Final Safety Analysis Report, Revision 13A.

6.4 GE Drawing 769E500 Rev. 0, "Mathematical Model" November 1977.

6.5 GENE-B11-00637-003 Rev. 0, "Edwin I. Hatch Nuclear Plant Unit 2 Shroud Repair Seismic Analysis Report for OBE, DBE & 1/2 SME", May, 1995.

6.6 SAP4G07, Users Manual, NEDO-10909, Rev. 7, 1979

6.7 25A5721 Rev. 0, "Shroud Stabilizers Code Stress Report".

6.8 GENE-B11-00637-002 Rev. 0, "Edwin I. Hatch Nuclear Plant Unit 2 Shroud & Repair Hardware Stress Analysis Report", May 1995.

6.9 NRC Generic Letter 94-03, July 25, 1994, "Intergranular Stress Corrosion Cracking of Core Shrouds in Boiling Water Reactors".

6.10 GENE-771-44-0894 Rev. 2, "Justification of Allowable Displacements of the Core Plate and Top Guide–Shroud Repair", November 1994.

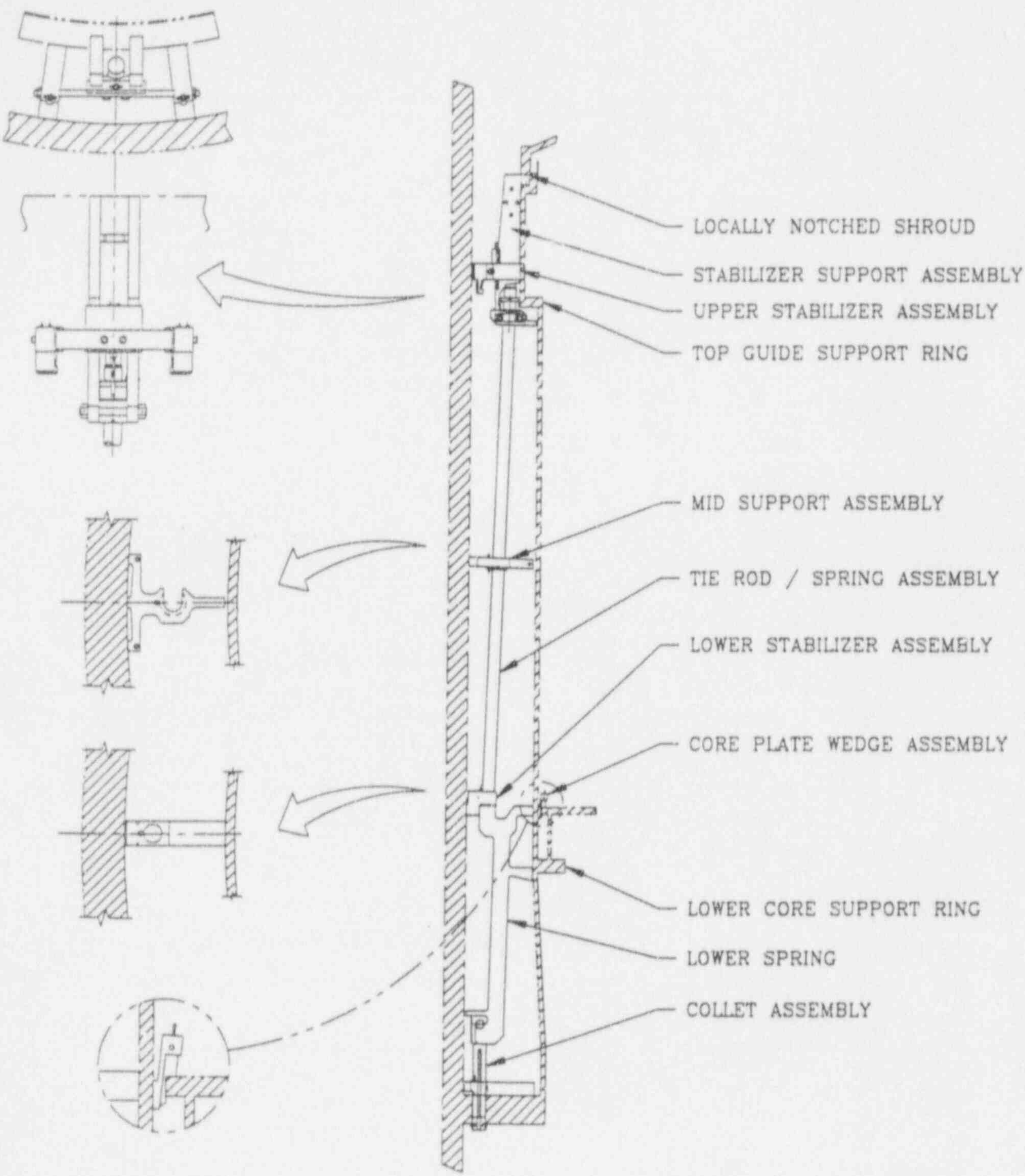

FIGURE 1 STABILIZER ASSEMBLY (4 REQUIRED)

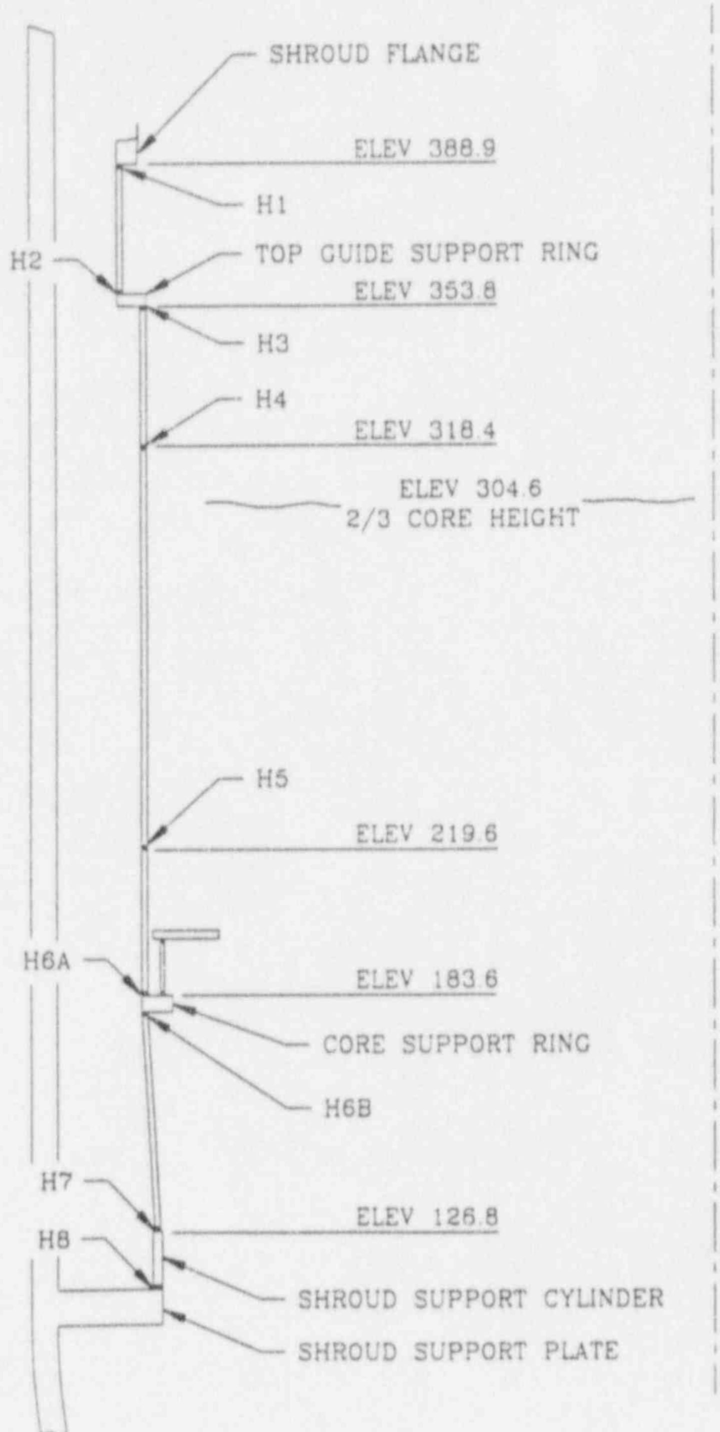

FIGURE 2 WELD NOMENCLATURE