June 24, 2010

Mr. W.S. Oxenford, Vice President,
Nuclear Generation and Chief Nuclear Officer
Columbia Generating Station
Energy Northwest
MD PE08
P.O. Box 968
Richland, WA 99352

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE COLUMBIA GENERATING STATION, LICENSE RENEWAL APPLICATION

Dear Mr. Oxenford:

By letter dated January 19, 2010, Energy Northwest submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54), to renew operating license NPF-21 for Columbia Generating Station, for review by the U.S. Nuclear Regulatory Commission (NRC or the staff). The staff is reviewing the information contained in the license renewal application and has identified, in the enclosure, areas where additional information is needed to complete the review. Further requests for additional information may be issued in the future.

Items in the enclosure were discussed with Abbas Mostala and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me at 301-415-4029 or by e-mail at evelyn.gettys@nrc.gov.

Sincerely,

/RA/

Evelyn Gettys, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-397

Enclosure:
As stated

cc w/encl: See next page

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COLUMBIA GENERATING STATION
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION

RAI B2.4-1

Background
The "monitoring and trending" program element of the GALL XI.M18 states that if bolting connections for pressure retaining components (not covered by American Society of Mechanical Engineer (ASME) Section XI) is reported to be leaking, then it may be inspected daily. If the leak rate does not increase, the inspection frequency may be decreased to biweekly or weekly.

Issue
The applicant has taken an exception to the Generic Aging Lessons Learned (GALL) Report for the "monitoring and trending" program element of the GALL XI.M18. Specifically, the frequency of follow-up inspections in the license renewal application (LRA) Section B.2.4 is established by engineering evaluation of the identified problem.

Request
Provide the technical basis and justification for adequacy of the event and plant-specific determination of the monitoring frequency, and state reasons for the alternative method to be as effective as the GALL prescription method to manage the bolting integrity over the extended period of operation.

RAI B2.4-2

Background
The GALL Report aging management program (AMP) XI.M18, "Bolting Integrity," states that the staff's recommendations and guidelines for comprehensive bolting integrity program for all safety-related bolting are delineated in NUREG-1339. The GALL AMP also notes EPRI NP-5769, with the exceptions noted in NUREG-1339, and EPRI TR-104213 as the industry's technical basis for this program. The Nuclear Regulatory Commission (NRC or the staff) Generic Letter GL 91-17 concerning the resolution of GSI-29 "Bolting Degradation or Failures in Nuclear Power Plants," notes the response of Nuclear Management and Resources Council on behalf of the industry. That response (in 1989) stated both the NP-5769 and the NP-5067, and not just the latter, to be the industry's technical basis for the resolution, and encouraged the use of both these documents. Further assessment of these documents and other industry experiences by the NRC staff resulted in NUREG-1339 and by EPRI led to TR-104213.

Issue
In element 1 (Scope of Program) and element 2 (Preventive Actions) of the LRA AMP the applicant states that it does not explicitly address the guidelines outlined in EPRI NP-5769, or as delineated in NUREG-1339, and instead relies on the recommendations contained in related EPRI document NP-5067. It is not clear that these statements are consistent, or the two bases are equivalent, since the single document used by the applicant is an earlier report and forms a subset of the GALL referenced three newer documents.

Other elements affected by the NP-5067 exception are: 4, 7, and 10. Also affected are the Program Description and final safety analysis report (FSAR) Supplement description for noting (change/exception) of the basis documents. These are not noted in the LRA exception.

ENCLOSURE

In its white paper, issued in January 2010, comparing certain aspects of NP-5067 with the GALL reference/basis documents, the applicant states the scope and focus of NP-5067 adequacy was on the aging mechanism of loss of preload in pressure retaining mechanical joints, which is only a subset of aging mechanisms and types of bolting covered under GALL XI.M18. Also, it is to be noted that NP-5067 is primarily "good practices" (maintenance) manual for solving maintenance problems as they occur and not necessarily focused on long-term management of aging issues—as the manual itself is well predated to license renewal effort—such as an evaluation procedure for assuring integrity, appropriate acceptance criteria, and managing of stress corrosion cracking in non-ASME bolting (unless the cracking leads to a leak that is detected).

Request

- Provide the justification for this exception and give basis for element by element equivalence of the NP-5067 with the other industry consensus documents and with the GALL XI.M18 elements based on these.
- Include in the LRA description all elements affected by the exception.

RAI B2.4-3

Issue

The "Operating Experience" (OE) described in LRA Section B2.4 notes that loss of preload, leaking joints and closures, corroded bolting connections have been identified and corrective actions taken. The staff noted several other instances of these aging effects in recent years, not discussed in the basis document. There is no consolidated list of these occurrences and their frequency over time to judge the effectiveness of this program, although the applicant states that the experience was reviewed and found to be effective.

Since ONLY leaks have been found, and NO cracking in ANY bolting application under the license renewal scope, these must come from improper assembly and/or loss of preload, reflecting on the training and implementation (under NP-5067).

Also, from the description in LRA Section B2.4 or the applicant's general review of industry-wide OE it is not clear if the applicant had addressed operating experience related to bolting integrity issues identified after issuance of the GALL Report. For instance, support bolt failure found in certain plants due to hydrogen-induced stress corrosion cracking.

Request

- Provide the basis for concluding from the OE the effectiveness of existing program to manage the aging effects over the extended period of operation.
- Provide justification for the timing and frequency of Columbia Generating Station (CGS) training in support of the implementation of proper procedures of assembly/disassembly or installation and inspection of the bolting.

- Provide an assessment to assure the effectiveness of the procedures to manage the bolting preload over the extended period of operation.
- Provide confirmation as to the adequacy of monitoring and detection of bolting degradation in those locations that are normally in submerged condition.

RAI B2.4-4

Background
The "Acceptance Criteria" element of GALL XI.M18, Bolting Integrity program states that "Any indications of aging effects in ASME pressure retaining bolting are evaluated in accordance with Section XI of the ASME Code. For other pressure retaining bolting, nuclear steam supply system (NSSS) component support bolting and structural bolting, indications of aging should be dispositioned in accordance with the corrective action process."

Issue
The applicant's program does not specify acceptance criteria for evidence of degradation particularly in the case of non-ASME evaluated bolting.

Request
Justify the lack of acceptance criteria to be adequate for the bolting integrity management and why the corrective action process is not implemented.

RAI B2.4-5

Background
The "Detection of Aging Effects" program element of GALL XI.M18 notes that the potential for stress corrosion cracking (SCC) of structural bolts/fasteners of NSSS component supports should be assessed based on the actual yield strength and for the identified high strength bolting (greater than 1-inch nominal diameter) volumetric examination comparable to that of Examination Category B-G-1 is required in addition to visual examination.

Issue
From the review of on-site documentation the staff could not confirm if the potential for SCC in the applicable bolting was evaluated and whether the actual yield strength values were factored in the evaluation. Based on the staff's discussion with applicant's technical staff it appears that only visual examination of these bolting is covered under the applicant's bolting program.

Request
Provide confirmation that the applicant has ascertained the high strength classification of NSSS bolting based on the actual yield strength values. Also, provide confirmation that so classified high strength bolting have been and will be inspected with visual and volumetric examinations as required, or provide justification for adequacy of waiver of the volumetric examination so that their intended function will be maintained consistent with the current licensing basis (CLB) for the period of extended operation, as required by 10 CFR 54.21(a)(3).

RAI B2.4-6

Background
GALL XI.M18, Bolting Integrity program, states that GALL Program XI.S3, "ASME Section XI Subsection IWF" manages inspection of safety-related bolting. This includes high strength bolting for which EPRI NP-5769 and EPRI TR-104213 recommend inspections for SCC to prevent or mitigate degradation and failure of structural bolting with actual yield strength greater than or equal to 150 ksi.

Request
- Provide confirmation that high strength bolting with yield strength greater than or equal to 150 ksi are employed as structural bolting, ASME component and piping supports bolting, NSSS support bolting, safety-related bolting and other pressure-retaining bolting under CGS aging management programs.
- Also, explain how the GALL recommendations to prevent or mitigate the degradation and failure of these bolts are implemented in the applicant's program to confirm that the aging effects of high strength bolting are adequately managed so that their intended function will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

RAI B.2.24-1

Background
LRA Section B.2.24 states that the Columbia Fatigue Monitoring program acceptance criteria are to maintain the number of counted transient cycles below the analyzed number of cycles for each transient. The LRA further states that when the accumulated cycles approach the analyzed design cycles, corrective action is required to ensure the analyzed number of cycles is not exceeded. Also, as part of the corrective action, the fatigue usage calculations may be updated.

The report further states that maintaining the fatigue usage factor below the design code limit and considering the effect of the environment will provide adequate margin against fatigue cracking of reactor coolant system components due to anticipated cyclic strains. The "detection of aging effects" program element of the GALL Report states that the program provides periodic update of the fatigue usage calculations.

Issue
This program is a preventive measure to mitigate fatigue cracking of metal components by maintaining the fatigue usage factor below the design code limit. One of the corrective actions when cumulative fatigue usage exceeds 1.0 is to refine the analysis to increase accuracy and decrease conservatism. This is achieved by using more realistic values for transient cycles and loading parameters such as strain rate and temperature during the transient. It is not clear whether the Columbia program includes more detailed local monitoring of the plant transient to obtain accurate values of the loading parameters for each transient and to validate the loading parameters that were used for the fatigue analysis, including environmental effects, for the critical components identified in NUREG/CR-6260. Also, in program element 7 "corrective action," the GALL Report recommends to include a review of additional affected reactor coolant pressure boundary.

Request
(a) Clarify how the Fatigue Monitoring program provides ongoing assessment of transients on plant components and monitors all plant transients that cause cyclic strains, which are significant contributors to fatigue usage.
(b) Address how periodic plant cycle tracking and trending lead to updating plant design basis fatigue analyses.
(c) Discuss corrective actions taken when the design code limit is projected to be exceeded during the period of extended operation.

RAI B.2.25-1

Background
Element 4 of the LRA AMP and the basis document states that the sequential starting/controller function tests for the diesel-driven fire pump is performed once every 5 years. In the GALL Report, it states periodic tests are performed at least once every refueling outage, such as flow and discharge tests, sequential starting capability tests, and controller functions tests for the diesel-driven fire pump.

Issue
The test interval of the sequential starting/controller function tests for the diesel-driven fire pump in the LRA AMP is much longer than the test interval recommended in the GALL Report. Degradation may not able be detected in a timely manner before there is a loss of component intended function due to the prolong test interval.

Request
Provide justification of the test interval of 5 years in the LRA AMP as compared to the interval of at least once every refueling outage recommended in the GALL Report.

RAI B.2.25-2

Background
Element 5 of the LRA AMP and the basis document states that there are no aging effects that require management for fire barrier walls/floors/ceiling, fire wraps, and fire proofing. It further states that the LRA Fire Protection Program will be used to confirm the absence of significant aging effects for the period of extended operation. The GALL Report states loss of material caused by chemical attack, reaction with aggregates, cracking, and spalling are aging effects for management of fire barriers (walls/floors/ceilings). The applicant's procedure for inspection of fire wraps states that the inspection is to ensure no obvious degradations such as splits, tears, holes, gaps or missing pieces. The applicant procedure for inspection of Thermo-lag states that the inspection is to verify Thermo-lag free of obvious holes, cracks, splits, voids, gouges, or broken pieces.

Issue
The applicant does not provide any justification that for fire barrier walls/floors/ceilings, fire wraps, and fire proofing, there are no aging effects that requires aging management.

Request
Provide justification why these aging effects mentioned above for fire barrier walls/floors/ceiling, fire wraps, and fire proofing, are considered not to require aging management during the extended period of operation.

RAI B.2.25-3

Background
Section B.2.25 of the LRA states that the Fire Protection Program will detect and manage loss of material, cracking, delamination, separation, and change in material properties for susceptible components. The LRA further states that the Fire Protection Program provides reasonable assurance that the aging effects will be managed such that components subject to aging management review will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation. An independent search by the staff identified an event in which 15 to 20 gallons of water spilled onto the floor of the Radwaste Building Cable Spreading Room (CSR), and leaked down into the Remote Shutdown Room and the Division II switchgear room below the CSR floor (LER 2002-003-00). The pathway for leakage through the floor of the CSR was through cracks in the concrete that allowed a penetration flood seal to be bypassed, and through shrinkage and flexural cracks in the concrete floor slab. The root cause of the event was unsealed cracks in the concrete floor slab.

Issue
The "operating experience" program element of the LRA AMP does not include a description of this LER or discuss any follow-up corrective action as a result of this event. The concrete floor fire barriers in the CSR appeared to have lost their intended function during this event.

Request
Describe the root cause evaluation of this event and the follow-up corrective action to ensure the intended function of the CSR floor fire barrier will be maintained in the period of extended operation.

RAI B2.25-4

Background
The LRA AMP and basis document states that neither the carbon dioxide suppression system nor the halon 1301 fire suppression systems is in the scope of license renewal. The GALL Report states that management of the aging effects of carbon dioxide suppression system and the halon 1301 fire suppression systems is included in the XI.M26 Fire Protection program.

Issue
During the audit, the applicant stated neither carbon dioxide suppression system nor the halon 1301 fire suppression systems is in the scope of license renewal because they are not required in the post-fire safe shutdown. However, it is not clear whether there were any systems or components added in the LRA when the halon 1301 fire suppression systems were removed from the scope of license renewal. If no systems and components were added, clarify which fire suppression system is being used for the control room.

Request
Clarity whether there were any systems or components added in the LRA when the halon 1301 fire suppression systems were removed from the scope of license renewal. If no systems and components were added, clarify which fire suppression system is being used for the control room.

RAI B.2.26-1

Background
In Columbia AMP B.2.26, the GALL AMP XI.M27 has been expanded to
(a) include components constructed of copper alloys, copper alloys >15% Zn, and stainless steels,
(b) manage loss of material due to erosion and macrofouling of all materials,
(c) manage cracking due to SCC/IGA of copper alloy >15% Zn components exposed to raw water (with ammonia), and
(d) manage loss of material due to selective leaching for the copper alloy >15% Zn components exposed to raw water.

Issue
The scope of the GALL AMP includes managing the loss of material due to corrosion, MIC, or biofouling of carbon steel and cast iron components exposed to raw water. It does not include cracking due to SCC or loss of material due to erosion, macrofouling, or selective leaching. This inclusion of other materials and other aging effects should be considered exceptions because GALL AMP program scope has been expanded to include other aging effects and components constructed of other materials. However, the LRA does not provide justification that the GALL AMP is adequate to manage loss of material due to corrosion, erosion, MIC, or biofouling, as well as selective leaching, and cracking due to SCC of components constructed of these materials.

Request
Provide justification that the Columbia AMP B.2.26, with the enhancement, is adequate to manage (a) loss of material due to erosion and macrofouling of carbon steel, cast iron, copper alloys, copper alloys >15% Zn, and stainless steels, and (b) loss of material due to corrosion (including MIC) as well as cracking due to SCC/IGA of copper alloys, copper alloys >15% Zn, and stainless steels exposed to raw water.

RAI B.2.26-2

Background
The scope of GALL AMP XI.M27 states that the Fire Water System program manages loss of material due to corrosion, microbiologically influenced corrosion (MIC), or biofouling of carbon steel and cast-iron components in the fire protection system exposed to raw water. The scope of Columbia AMP states that the Fire Water program manages loss of material due to crevice, galvanic, general, and pitting corrosion, erosion and cavitation erosion, as well as MIC and macrofouling of susceptible materials in the Fire Protection system, including water supply components, which are exposed to raw (impure) water.

Also, the GALL AMP applies to water-based fire protection systems that consist of sprinklers, nozzles, fittings, valves, hydrants, hose stations, standpipes, water storage tanks, and above

and underground piping and components that are tested in accordance with the applicable National Fire Protection Association codes and standards. The Columbia AMP is applicable to a variety of materials including carbon steel, gray cast iron, copper alloy, copper alloy >15% Zn, and stainless steel, for piping and piping components such as valve bodies, tubing, strainer bodies, standpipes (piping), sprinklers (spray nozzles), pump casings, and hydrants.

In addition, the GALL AMP recommends periodic flow testing of the fire water system or wall thickness evaluations (e.g., volumetric or visual inspections) be performed to ensure that the system maintains its intended function; and that these inspections be performed before the end of the current operating term and at plant-specific intervals thereafter during the period of extended operation. The Columbia B.2.26 AMP states that the existing program will be enhanced to perform either ultrasonic testing or internal visual inspection of representative portions of above ground fire protection piping that are exposed to water, but do not normally experience flow, after the issuance of the renewal license, but prior to the end of the current operating term and at reasonable intervals thereafter, based on engineering review of the results.

Issue
The Columbia LRA or the basis document does not provide sufficient details regarding the aging management for portions of fire water systems that are (a) normally empty (dry) and (b) below ground. Also, it is not clear whether normally-dry components are indoors or outdoors.

Request
Provide a list of fire water system piping and components (and whether they are indoor or outdoor), that are (a) normally empty (dry) and (b) below ground, and describe the aging management program(s) for each of these two type of components.

RAI B2.33-1

Background
The “Program Description” of the GALL AMP XI.M1 states that Title 10 of the *Code of Federal Regulations*, (10 CFR 50.55a), imposes the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, for Class 1, 2, and 3 pressure-retaining components and their integral attachments in light-water cooled power plants, and that the inspection, repair, and replacement of these components are covered in Subsections IWB, IWC, and IWD, respectively, in the 2001 edition including the 2002 and 2003 Addenda. The GALL AMP XI.M1 also indicates that an applicant may refer to the Statement of Consideration” for an update of 10 CFR 50.55a to justify use of a more recent edition of the Code.

Issue
The applicant’s “Program Description” of the ISI program under its LRA Section B2.33 does not specify the applicable Code edition(s) in current use and for the extended period of operation for the ISI program

Request

Clarify the ASME Code edition currently incorporated in the existing ISI program, and if different from that specified under GALL AMP XI.M1, provide the basis. Also, confirm if the ASME Code edition, to be incorporated by CGS for the future inspection intervals during the period of extended operation, would be the ASME Section XI Code editions and addenda, as modified and limited in the 10 CFR 50.55a rule, that are considered acceptable by the staff in the *Federal Register* Notice for future 10 CFR 50.55a amendments.

RAI B2.33-2

Background
Inspections under the ASME Section XI, Subsections IWB, IWC, and IWD, in general, and the GALL AMP XI.M1, in particular, provide for the detection of aging effects to reveal cracking, loss of material due to corrosion, leakage of coolant and indications of degradation due to wear or stress relaxation, but not the reduction of fracture toughness. Also, the "Program Description" of GALL AMP XI.M1 does not include thermal embrittlement or the resulting loss of fracture toughness.

Issue
The applicant's ISI program under its LRA Section B2.33 and the FSAR Supplement Section A1.2.33 indicates that it manages the reduction of fracture toughness due to thermal embrittlement of cast austenitic stainless steel pump casings and valve bodies.

Request
The applicant should cover this addition of aging management issue as an enhancement to its existing ISI program and provide the basis and justification for the enhancement.

RAI B2.33-3

Background
The intergranular stress corrosion cracking (IGSCC) of boiler water reactor (BWR) piping components, discussed in NRC GL 88-01, continues to be a significant aging effect also addressed in the applicant's LRA Section B2.33 and the Final Safety Analysis Report (FSAR) Supplement Section A1.2.33, with augmented ASME Section XI ISI program.

Issue
The nature and scope of augmented ISI program to address GL 88-01 were not apparent from the LRA program description. Also, in particular, if the applicant is crediting any mitigation measures, what these measures are, what is the impact on the scope of related inspections as required by the ASME Section XI ISI, and what is the justification for their adequacy over the extended period of operation.

Request
Clarify the extent of augmented ISI program to manage the GL 88-01 impacted components. Justify any current or planned reduction in ISI scope (frequency and locations) originally identified in response to the GL 88-01, as a result of plant-specific mitigation measures or related industry initiatives, and why the augmentation is considered to be adequate to manage this IGSCC issue over the extended period of operation.

RAI B2.33-4

Issue
The FSAR Section 5.2.4, which describes the applicant's ISI Program only by reference, indicates (page 5.2-22 of the FSAR) that about 16% of the vessel weld volume is inaccessible.

Request
Clarify the location and distribution of the inaccessible weld regions of the vessel. Justify the adequacy of existing ISI program coverage to manage the aging related degradation of these regions so that their intended function will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

RAI B.2.45-1

Background
In LRA Section B.2.45 Program Description, the applicant stated that the Columbia Reactor Head Closure Studs program manages cracking due to SCC and loss of material due to corrosion for the reactor head closure stud assemblies (studs, nuts, washers, and bushings). The applicant further stated that the B.2.45 program is an existing Columbia program that is consistent with the 10 elements of an effective management program as described in NUREG-1801, Section XI.M3 "Reactor Head Closure Studs" program.

The GALL Report states that the Reactor Head Closure Studs program includes ISI to detect cracking due to SCC or IGSCC, loss of material due to wear, and coolant leakage from reactor vessel closure stud bolting for both BWRs and pressure water reactors. The "detection of aging effects" program element of the GALL AMP states that inspection can reveal cracking, loss of materials due to corrosion or wear, and leakage of coolant.

Issue
The program description in LRA Section B.2.45 states that the program manages loss of material due to corrosion. Loss of material due to wear is not mentioned either in the program description or "detection of aging effects" program element.

Request
Verify that the Columbia Reactor Head Closure Studs program also manages the loss of material due to wear, or justify why wear is not considered as a significant degradation mechanism.

RAI B.2.45-2

Background
In LRA Section B.2.45 the applicant stated that the Reactor Head Closure Studs program examines reactor vessel stud assemblies in accordance with the examination and inspection requirements specified in Table IWB-2500-1. Inspections include VT-1 visual examination of the nuts, washers, and bushing and volumetric examination of studs and threads, and VT-2 inspections for leak detection are performed during system pressure tests. The applicant also noted that the inspection of the reactor vessel closure studs, performed in accordance with ASME Code, Section XI, Subsection IWB, Table IWB 2500-1 (2003 addenda), includes volumetric examinations rather than the surface examinations called out in paragraph NB-2545

or NB-2546 of Section III of the ASME Code. The GALL AMP XI.M3 states that the program includes ISI in accordance with the requirements of the ASME Code Section XI, Subsection IWB (2001 edition including 2002 and 2003 addenda), Table IWB 2500-1.

Also, in LRA Appendix C, Table C-11, in response to license renewal applicant action item (1) of NRC safety evaluation report for BWRVIP-74 "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines," the applicant stated:

> "The BWR Vessel Internals Program (VIP) requires the inspection and evaluation guidelines of this BWRVIP report to be implemented at Columbia. Site procedures require a technical justification to be documented for any deviation from the guidelines. Columbia has not identified any deviation from the BWRVIP-74-A guidelines. Therefore, Columbia is bounded by the BWRVIP-74-A report."

Issue

The staff noted that Section 4.1.2 of the BWRVIP-74-A report states that vessel closure head studs (Category B-G-1, greater than 2 inches in diameter) require ultrasonic examination inservice when the examination is done in place, and both surface and ultrasonic examination if they are removed for examination. Therefore, since the applicant's program includes only volumetric examination, for its program to be consistent with the GALL AMP XI.M3 and also with BWRVIP-74-A guidelines, the applicant seems to be committing to only one option for ISI of studs, i.e., volumetric examination of the studs in place.

Request

Clarify that the existing Reactor Head Closure Studs program being proposed for managing aging degradation of the closure stud assemblies due to cracking and loss of material during the extended period, includes volumetric examination of the studs in place, and that the studs are not examined when they are removed.

Letter to W. Oxenford from E. Gettys dated June 24, 2010

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE COLUMBIA GENERATING STATION, LICENSE RENEWAL APPLICATION

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