May 12, 2006

Mr. Christopher M. Crane
President and Chief Nuclear Officer
Exelon Nuclear
Exelon Generation Company, LLC
200 Exelon Way, KSA 3-E
Kennett Square, PA 19348

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNIT 3 - ISSUANCE OF AMENDMENT RE: EXTENSION OF PRESSURE-TEMPERATURE LIMITS SPECIFIED IN TECHNICAL SPECIFICATIONS (TAC NO. MC7519)

Dear Mr. Crane:

The Commission has issued the enclosed Amendment No. 263 to Renewed Facility Operating License No. DPR-56 for Peach Bottom Atomic Power Station, Unit 3. This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated July 6, 2005, as supplemented by letters dated March 15, 2006, and April 7, 2006.

The proposed changes modify the TSs to extend the use of the current pressure-temperature limits as specified in TS Figure 3.4.9-1, “Temperature/Pressure Limits for Inservice Hydrostatic and Inservice Leakage Tests”; Figure 3.4.9-2, “Temperature/Pressure Limits for Non-Nuclear Heatup and Cooldown Following Shutdown”; and Figure 3.4.9-3, “Temperature/Pressure Limits for Criticality,” from 22 effective full-power years (EFPYs) to 32 EFPYs.

A copy of our Safety Evaluation is also enclosed. Notice of Issuance will be included in the Commission’s Biweekly *Federal Register* Notice.

Sincerely,

/RA by Theresa M. Valentine for/

Richard V. Guzman, Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-278

Enclosures:
1. Amendment No. 263 to Renewed DPR-56
2. Safety Evaluation

cc w/encls: See next page

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Official Record Copy

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EXELON GENERATION COMPANY, LLC

PSEG NUCLEAR LLC

DOCKET NO. 50-278

PEACH BOTTOM ATOMIC POWER STATION, UNIT 3

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 263
Renewed License No. DPR-56

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Exelon Generation Company, LLC (Exelon Generation Company), on behalf of itself and PSEG Nuclear LLC (the licensees), dated July 6, 2005, as supplemented by letters dated March 15, 2006, and April 7, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission’s regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission’s regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C(2) of Renewed Facility Operating License No. DPR-56 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 263, are hereby incorporated in the license. Exelon Generation Company shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Darrell J. Roberts, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: May 12, 2006

ATTACHMENT TO LICENSE AMENDMENT NO. 263

RENEWED FACILITY OPERATING LICENSE NO. DPR-56

DOCKET NO. 50-278

Replace the following pages of the Appendix A Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
3.4-25	3.4-25
3.4-26	3.4-26
3.4-27	3.4-27

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 263 TO RENEWED FACILITY OPERATING

LICENSE NO. DPR-56

EXELON GENERATION COMPANY, LLC

PSEG NUCLEAR LLC

PEACH BOTTOM ATOMIC POWER STATION, UNIT 3

DOCKET NO. 50-278

1.0 INTRODUCTION

By application dated July 6, 2005, as supplemented by letters dated March 15, 2006, and April 7, 2006, Exelon Generation Company, LLC (the licensee), requested changes to the Technical Specifications (TSs) for Peach Bottom Atomic Power Station, Unit 3 (PBAPS 3). Specifically, the proposed changes would extend the use of the current pressure-temperature (P-T) limits as specified in the TSs from 22 effective full-power years (EFPYs) to 32 EFPYs. These limits are provided in Figure 3.4.9-1, "Temperature/Pressure Limits for Inservice Hydrostatic and Inservice Leakage Tests"; Figure 3.4.9-2, "Temperature/Pressure Limits for Non-Nuclear Heatup and Cooldown Following Shutdown"; and Figure 3.4.9-3, "Temperature/Pressure Limits for Criticality."

2.0 REGULATORY EVALUATION

The Nuclear Regulatory Commission (NRC or the Commission) has established requirements in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, to protect the integrity of the reactor coolant pressure boundary in nuclear power plants. General Design Criterion (GDC) 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, requires that the reactor coolant pressure boundary be designed with sufficient margin to ensure that, when stressed under operating, maintenance, testing, and postulated accident conditions, the boundary behaves in a non-brittle manner and the probability of rapidly propagating fracture is minimized. GDC 31 also requires that the design reflect the uncertainties in determining the effects of irradiation on material properties. Appendix G, "Fracture Toughness Requirements," and Appendix H, "Reactor Vessel Material Surveillance Program Requirements," to 10 CFR Part 50 necessitate the calculation of changes in fracture toughness of reactor pressure vessel (RPV) materials caused by neutron radiation throughout the service life.

The fracture toughness of RPV materials is related to a parameter called the material's "reference temperature for nil-ductility transition," denoted as RT_{NDT}. The RT_{NDT} is defined in Revision 2 of Regulatory Guide (RG) 1.99, "Radiation Embrittlement of Reactor Vessel Materials," by a correlation of the fast neutron fluence, material chemistry, initial reference temperature, and margin to account for uncertainties in the correlation and input values. RG 1.99, Revision 2 contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy resulting from neutron radiation.

Appendix G to 10 CFR Part 50 includes P-T limits for the RPV. These limits are defined by the operating condition (i.e., hydrostatic pressure and leak tests, or normal operation including anticipated operational occurrences), the vessel pressure, whether or not fuel is in the vessel, and whether the core is critical. Appendix G to 10 CFR Part 50 requires that facility P-T limit curves for the RPV be at least as conservative as those obtained by applying the methodology of Appendix G to Section XI of the American Society for Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code Section XI). The 2001 Edition through the 2003 Addenda provide the most recent version of Appendix G to ASME Code Section XI. This version has been endorsed in 10 CFR 50.55a and, therefore, by reference in Appendix G to 10 CFR Part 50. This edition of Appendix G to ASME Code Section XI incorporates the provisions of ASME Code Case N-588, "Alternative to Reference Flaw Orientation of Appendix G for Circumferential Welds in Reactor Vessels, Section XI, Division 1," and ASME Code Case N-640, "Alternative Reference Fracture Toughness for Development of P-T Limit Curves, Section XI, Division 1." In addition, Appendix G to 10 CFR Part 50 imposes minimum head flange temperatures when system pressure is at or above 20 percent of the pre-service hydrostatic test pressure.

The basic parameter of the methodology specified in Appendix G to ASME Code Section XI is the stress intensity factor K_I, which is a function of the stress state and flaw configuration. Appendix G requires a safety factor of 2.0 on stress intensity factors resulting from reactor pressure during normal and upset operating conditions, and a safety factor of 1.5 for hydrostatic testing curves. Appendix G also requires a safety factor of 1.0 on stress intensity factors resulting from thermal loads for normal and upset operating conditions as well as for hydrostatic testing. The methods of Appendix G postulate the existence of a sharp surface elliptical flaw in the RPV that is normal to the direction of the maximum stress. This flaw is postulated to have a depth that is equal to 1/4 of the RPV beltline thickness and a length equal to 1.5 times the RPV beltline thickness. The critical locations in the RPV beltline region for calculating heatup and cooldown P-T limit curves are the 1/4 thickness (1/4T) and 3/4 thickness (3/4T) locations, which correspond to the maximum depth of the postulated inside surface and outside surface defects, respectively.

The methodology specified in Appendix G to ASME Code Section XI requires that licensees determine the adjusted reference temperature (ART or adjusted RT_{NDT}) at 1/4T and 3/4T locations. The ART is defined as the sum of the initial unirradiated reference temperature (initial RT_{NDT}), the mean value of the adjustment in reference temperature caused by irradiation (ΔRT_{NDT}), and a margin (M) term.

The ΔRT_{NDT} is a product of a chemistry factor (CF) and a fluence factor. The CF is dependent upon the amount of copper and nickel in the material and may be determined from tables in RG 1.99, Revision 2, or from surveillance data. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depth. RG 1.190, "Calculational and

Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," provides methods for calculating the fast neutron fluence (where the energy of the neutrons is greater than 1 million electron-volts, or E > 1 MeV). The RG 1.190 guidance is based on the requirements of GDC 14, "Reactor Coolant Pressure Boundary," GDC 30, "Quality of Reactor Coolant Pressure Boundary," and GDC 31. Appendix H to 10 CFR Part 50 requires the installation of surveillance capsules, including material test specimens and flux dosimeters, to provide data for material damage correlations as a function of fluence.

The margin term is dependent upon whether the initial RT_{NDT} is a plant-specific or a generic value and whether the CF was determined using the tables in RG 1.99, Revision 2 or surveillance data. The margin term is used to account for uncertainties in the values of the initial RT_{NDT}, the copper and nickel contents, the fluence and the calculational procedures. RG 1.99, Revision 2 describes the methodology to be used in calculating the margin term.

The staff evaluates P-T limit curves based on the following NRC regulations and guidance:

- Appendix G to 10 CFR Part 50;
- Generic Letter (GL) 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and its Impact on Plant Operations";
- GL 92-01, Revision 1, "Reactor Vessel Structural Integrity";
- GL 92-01, Revision 1, Supplement 1, "Reactor Vessel Structural Integrity"; and
- Standard Review Plan (SRP) Section 5.3.2, "Pressure-Temperature Limits and Pressurized Thermal Shock."

GL 88-11 advised licensees that the staff would use RG 1.99, Revision 2 to review P-T limit curves. GL 92-01, Revision 1 requested that licensees submit their RPV data for their plants to the staff for review. GL 92-01, Revision 1, Supplement 1 requested that licensees provide and assess data from other licensees that could affect their RPV integrity evaluations. These data are used by the NRC staff as the basis for the review of P-T limit curves. SRP Section 5.3.2 provides an acceptable method of determining the P-T limit curves for ferritic materials in the beltline of the RPV based on the linear elastic fracture mechanics methodology of Appendix G to ASME Code Section XI.

3.0 TECHNICAL EVALUATION

3.1 Licensee Evaluation

Pursuant to 10 CFR 50.90, the licensee submitted a request to the NRC staff for the approval of TS changes with respect to the P-T limit curves for PBAPS 3 (Reference 1). The proposed amendment would extend the use of the current P-T limits as specified in TS Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3 from 22 EFPYs to 32 EFPYs.

The licensee stated that it performed a bounding calculation of the reactor vessel 32 EFPY fast neutron fluence for PBAPS 3 using the General Electric (GE) NEDC-32983P licensing topical report (LTR), "General Electric Methodology for Reactor Pressure Vessel Fast Neutron Flux Evaluation." In a Safety Evaluation dated September 14, 2001, the NRC staff found the GE methodology, as proposed in the LTR, acceptable for referencing in licensing actions.

The operating condition assumed by the licensee for the flux calculation was based on the projected Limerick Generating Station, Unit 2 (LGS 2), Cycle 6 core data. In response to the staff's request for additional information (Reference 4), the licensee stated the basis for using LGS 2 data, and provided the similarities between LGS 2 and PBAPS 3 that allowed them to use the analogy. The in-vessel components that have significant impacts on vessel flux distribution are very similar for PBAPS 3, and LGS 2.

For example, the following parameters are identical between these two units:

- Vessel inside diameter (design value)
- Core shroud inside diameter and thickness
- Size and azimuthal locations of jet pump mixers and risers
- Azimuthal location of surveillance capsules, all shadowed by jet pump riser
- Number of fuel bundles (764) and bundle layout

Furthermore, the licensee stated that the core loading for a representative cycle (Cycle 12) of PBAPS 3, consisted of GE fuel designs similar to that of LGS 2, Cycle 6 core loading; and thus, the loaded fuels were also similar between the two units.

In general, the peak vessel flux is influenced by a small number of fuel bundles in the core periphery that are closest to the peak flux location. The most important bundle for the peak vessel flux was the closest bundle, which was identified as (I=22, J=1). Comparison of cycle energy for the peak bundle and neighboring bundles showed that PBAPS 3, Cycle 12 had significantly lower cycle energy for these important bundles than the corresponding LGS 2, Cycle 6 bundles. The licensee, therefore, concluded that vessel flux for PBAPS 3 is bounded by that of LGS 2, Cycle 6.

The licensee also stated, consistent with the guidance provided in RG 1.190, that P_3 truncation of the Legendre polynomial expansion of the scattering cross sections and an S_{12} fully symmetric angular quadrature set were used in the neutron transport calculation.

For the purpose of the neutron fluence evaluation, the licensee assumed that the unit had operated at 3458 megawatts thermal (MWt), approximately 5% above the unit's original licensed power level, since the commencement of power operation in 1974. The licensee concluded that by making this assumption, the neutron fluence evaluation to 32 EFPYs of operation would bound the actual plant operational history, which consisted of operation at approximately 3290 MWt through 1995, before recent power uprates increased the plant's licensed thermal power output to 3514 MWt.

In response to the NRC staff's request for additional information (Reference 2), the licensee provided supplemental information (Reference 3) that included the ART calculations for the PBAPS 3 plates and welds at the 1/4T location of the RPV for the calculated fluence at 32 EFPYs. The licensee indicated that part of the analysis involved in developing P-T limit curves is to account for radiation embrittlement effects in the beltline region. The licensee indicated that the method used to account for radiation embrittlement was the method as described in RG 1.99, Revision 2. For the PBAPS 3 RPV, the licensee determined that the most limiting material at the 1/4T location is the lower intermediate shell plate heat C2773-2.

The ART value, the neutron fluence, and the ΔRT_{NDT} values at the 1/4T location of the limiting intermediate shell plate for PBAPS 3 are provided below:

EFPY	Neutron Fluence (n/cm^2) – E > 1 MeV	ΔRT_{NDT} (^{0} F)	ART (^{0} F)
32	9.2×10^{17}	42	86

Based on the limiting material ART value, the licensee then developed comparison P-T curves using a methodology consistent with the most recent staff-endorsed edition and addenda of Appendix G to ASME Code Section XI. The most recent edition and addenda of Appendix G to ASME Code Section XI permits the application of the lower bound plane strain static testing fracture toughness equation (K_{IC} equation) as the basis for establishing the P-T limit curves in lieu of using the lower bound crack arrest/dynamic testing fracture toughness equation (i.e., the K_{IA} equation) that was used in the development of the unit's existing P-T limit curves.

The licensee stated in Reference 3 that the P-T limit curves for the heatup and cooldown operating condition at a given EFPY apply for both 1/4T and 3/4T locations. Thermal gradient tensile stresses exist near the inside diameter of the RPV wall during cooldown and near the outside diameter of the RPV wall during the heatup period. As a conservative simplification, the licensee's analysis assumed the thermal gradient stress at the 1/4T location to be tensile for both heatup and cooldown.

The licensee stated that this approach is conservative and makes the 1/4T location bounding for both heatup and cooldown because radiation effects cause the allowable toughness at 1/4T to be less than that at 3/4T for a given metal temperature. In addition, the licensee provided the results of the P-T calculations over the entire pressure range of operation for the RPV as an attachment to Reference 3.

In addition to the beltline considerations, limits related to non-beltline discontinuities such as nozzles, penetrations, and flanges influence the construction of P-T limit curves. The non-beltline limits are based on generic analyses that are adjusted to the maximum RT_{NDT} for the applicable vessel components. Curves were included to allow monitoring of the vessel bottom head and upper vessel regions, separate from the beltline region, to help minimize heating requirements prior to pressure testing. However, since these non-beltline regions are not subject to significant radiation effects, these curves are not effectively limited to any specific EFPY level.

The licensee then indicated that the existing PBAPS 3 curves (compared to the newly generated P-T curves) are bounding through 32 EFPYs. Accordingly, the licensee requested that the PBAPS 3 TS Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3 be revised to extend the applicability of the existing P-T curves to 32 EFPYs of operation.

3.2 Staff Evaluation

The NRC staff noted that the licensee, in lieu of submitting new curves valid for 32 EFPYs of operation, opted to extend the use of the current P-T limits specified in TS Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3 from 22 EFPYs to 32 EFPYs.

As stated above, the licensee used the GE methodology as provided in the GE NEDC-32983P LTR for calculating the reactor vessel 32 EFPYs fast neutron for PBAPS 3. The staff's Safety Evaluation of the LTR states that the methodology provides an acceptable best-estimate prediction of the RPV neutron fluence, complies with the requirements of RG 1.190, and is acceptable for referencing in licensing actions. The staff also agreed with the licensee's determination that the assumptions made in the fluence analysis would make the results accurate or conservative relative to the actual plant conditions. Therefore, the staff found the licensee's 32 EFPYs peak 1/4T fluence value of 9.2×10^{17} n/cm^2 acceptable for the limiting lower intermediate shell plate (shell #2 plate).

The staff performed an independent calculation of the ART values for the limiting beltline material using the methodology in RG 1.99, Revision 2. Based on these calculations, the staff verified that the licensee's limiting material for the RPV is the lower intermediate shell plate heat C2773-2. The staff's calculated ART values for the limiting material agreed within ± 2 EF of the licensee's calculated ART values.

In order to perform an independent assessment of the existing PBAPS3 P-T limit curves, the staff requested that the licensee provide the P-T calculations over the entire temperature range for the comparison P-T curves developed based on the most recent staff-approved version of Appendix G to ASME Code Section XI (Reference 2). The staff further requested that the licensee provide the adjusted pressure value for each temperature value assessed, based on the limiting ART values for the PBAPS 3 RPV. As an attachment to Reference 3, the licensee provided GE-NE-B13-02119-00-01, which included the P-T calculations for the comparison P-T curves and the basis and methodology used for the development of the curves, considering all regions of the RPV. The GE report also included tables of the P-T calculations over the entire pressure range of operation for the RPV.

The staff then evaluated the licensee's extension of the existing P-T limit curves for the beltline region to 32 EFPYs by performing independent calculations using the methodology referenced in ASME Code Section XI (as indicated by SRP 5.3.2). The staff independently generated P-T limit curves for normal operations and hydrostatic test pressures to the specified EFPYs. The staff's calculations utilized the same assumptions regarding the consistent application of tensile K_{It} stresses at the 1/4T location as were made in the development of the licensee's comparison P-T limit curves. By comparing the independently generated P-T limit curves with the licensee's current P-T limit curves, the staff determined that the licensee's existing P-T limit curves, if extended to 32 EFPYs, continue to meet the requirements of 10 CFR Part 50, Appendix G.

In addition to beltline materials, Appendix G of 10 CFR Part 50 also imposes a minimum temperature at the closure head flange based on the reference temperature for the flange material. Section IV.A.2 of Appendix G states that when the pressure exceeds 20 percent of the pre-service system hydrostatic test pressure, the temperature of the closure flange regions (highly stressed by the bolt preload) must exceed the reference temperature of the material in those regions by at least 120 EF for normal operation, and by 90 EF for hydrostatic pressure tests and leak tests. The staff has determined that the proposed P-T limits satisfy the requirement for the closure flange region during normal operation and inservice leak and hydrostatic testing.

The staff reviewed the licensee's method of establishing the bolt-up temperature using a temperature 60 °F greater than the limiting initial RT_{NDT} for the closure flange region or the lowest service temperature (LST) of the bolting materials, whichever is greater. The limiting initial RT_{NDT} for the closure flange region is 10 °F, which is represented by both the top head and vessel shell flange materials. The LST of the closure studs is 70 °F. Therefore, the bolt-up temperature of 70 °F is acceptable.

The staff has concluded, based on its review, that the existing P-T limit curves, if extended to 32 EFPYs, are conservative relative to those generated by the staff in accordance with 10 CFR Part 50, Appendix G requirements, the updated fluence calculation, and the most recent edition and addenda of the ASME Code, Section XI, Appendix G. Extension of the existing curves to 32 EFPYs is, therefore, acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (70 FR 44402). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. Letter from P.B. Cowan, Exelon, to NRC, "Proposed Changes to Extend the Use of Pressure-Temperature Limits Specified in Technical Specifications Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3," dated July 6, 2005.

2. Letter from R.V. Guzman, NRC, to C.M. Crane, Exelon, "Peach Bottom Atomic Power Station Unit No. 3 - Request for Additional Information (RAI) Regarding Proposed Pressure - Temperature Curves (TAC No. MC7519)," dated January 26, 2006.

3. Letter from P.B. Cowan, Exelon, to NRC, "Response to Request for Additional Information - License Amendment Request, 'Proposed Changes to Extend the Use of Pressure-Temperature Limits Specified in Technical Specifications Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3' (TAC No. MC7519)," dated March 15, 2006.

4. Letter from P.B. Cowan, Exelon, to NRC, "Response to Request for Additional Information - License Amendment Request, 'Proposed Changes to Extend the Use of Pressure-Temperature Limits Specified in Technical Specifications Figures 3.4.9-1, 3.4.9-2, and 3.4.9-3' (TAC No. MC7519)," dated April 7, 2006.

Principal Contributors: M. Khanna
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Date: May 12, 2006