JUL 10 1985

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APPLICANTS: Duke Power Company (DPC)
North Carolina Municipal Power Agency Number 1
North Carolina Electric Membership Corporation
Piedmont Municipal Power Agency
Saluda River Electric Cooperative, Inc.

FACILITY: Catawba Nuclear Station (CNS), Unit 2

SUBJECT: SAFETY EVALUATION REPORT - REVIEW OF APPLICATION DATED JUNE 20, 1984, AND ITS SUPPLEMENTS DATED JANUARY 18, JUNE 19, JUNE 21, and JULY 1, 1985 FOR A SPECIAL NUCLEAR MATERIALS LICENSE

I. INTRODUCTION

A. General

By application dated June 20, 1984, and its supplements dated January 18, June 19, June 21, and July 1, 1985, Duke Power Company (DPC) acting on its own behalf and as agent for the applicants listed above, requested authorization to receive, inspect, possess, and store enriched uranium contained in fresh fuel assemblies and fission chambers; and to receive, inspect, possess, store, and use a sealed Pu-Be neutron source. The materials are for eventual use in CNS, Unit 2.

On January 16, 1984, the Nuclear Regulatory Commission (NRC) issued Materials License No. SNM-1920 authorizing DPC to receive, possess, inspect, and store uranium contained in fresh fuel assemblies at its CNS, Unit 1 facility. In addition, License No. SNM-1920 also authorized the receipt and storage of fission chambers, Pu-238 contained in two Pu-Be neutron sources, and a plutonium alpha source set containing 2 μCi Pu-239 at CNS, Unit 1. Based on information provided by DPC, Unit 2 is nearly identical to Unit 1. This fact was confirmed in conversations with the NRR Project Manager, Senior Resident Inspector, utility staff members, and staff review of the two applications. Therefore, much of the work and analysis on the Unit 2 Safety Evaluation Report will be based on prior work performed by NRC staff on CNS, Unit 1.

By letter dated January 18, 1985, DPC supplemented their application by requesting that Piedmont Municipal Power Agency be included as a 25 percent partner in CNS, Unit 2.

The materials license was requested to allow early receipt of the fuel for the purpose of inspection and preparation of the fuel for reactor loading. The materials license will automatically terminate upon issuance of the Part 50 operating license.

B. Fuel Assembly Design

The finished fuel assemblies for CNS, Unit 2, will be supplied by the Westinghouse Electric Corporation. Each fuel assembly contains 264 fuel pins, 24 guide thimble tubes, and 1 instrumentation thimble tube. The fuel pins, guide thimble tubes, and instrumentation thimble tube are spaced in a 17 x 17 array and supported by six zircaloy spacer grids, two inconel end grids, and two end fittings. Table 1 gives general fuel parameters that describe the fuel which will eventually be used in CNS, Unit 2.

TABLE 1

CATAWBA NUCLEAR STATION - UNIT 2

General Fuel Data

Fuel Assembly Data	Inches
Overall Length	151.6
Nominal Active Fuel Length	144.0
Fuel Rod Pitch	0.496
Rod Array	17 x 17
Rods Per Assembly	264
Fuel Rod Data	
Fuel Pellet Material	UO_2
Outside Diameter	0.360
Cladding Thickness	0.0225
Cladding Inside Diameter	0.315
Fuel Pellet Immersion Density (% theoretical)	95.0
Fuel Pellet Diameter	0.3088

C. Location Description

The CNS, Unit 2, is a PWR located on the shore of Lake Wylie in York County, South Carolina. The construction permit, CPPR-117, was issued on August 7, 1975 (Docket Number 50-414).

II. AUTHORIZED ACTIVITIES

A. Enriched Uranium Fuel Assemblies

This license will authorize the receipt, possession, inspection, and storage of 196 finished fuel assemblies with a maximum enrichment of a

3.15 w/o in U-235. Fuel assemblies will be stored in their shipping containers, the New Fuel Storage Vault, and the Spent Fuel Storage Facility.

DPC also requests authorization to repackage any assembly, if necessary, for delivery to a carrier. It should be noted that the license does not authorize insertion of a fuel assembly into the reactor vessel.

B. Fission Chambers

The license will authorize the receipt, possession, inspection, and storage of 12 fission chambers. The total quantity of U-235 in each detector is less than 5 milligrams.

C. Pu-Be Neutron Source

The license will authorize the receipt, possession, inspection, use, and storage of one Pu-Be source containing a maximum of 5 curies.

III. SCOPE OF REVIEW

The staff's safety review of the DPC request for a materials license included an evaluation of the Catawba Nuclear Station organization, administration, nuclear criticality safety, radiation protection, and fire protection program.

During the course of the review, discussions were held with the NRR Project Manager, the Senior Resident Inspector, Region II, and DPC staff members. All sources verified that the storage facilities for the fuel assemblies are identical for both Catawba Units 1 and 2. Therefore, much of the safety review for Unit 1 is also applicable for Unit 2.

The evaluation of the physical security plan for the site was made by the Physical Security Licensing Branch, Division of Safeguards, Office of Nuclear Material Safety and Safeguards.

IV. POSSESSION LIMITS

Conditions 6, 7, and 8 of this license will specify the type, form, and quantity of material DPC may possess under this license and shall read as follows:

6. Material	7. Form	8. Quantity
A. Uranium enriched in the U-235 isotope	A. In unirradiated reactor fuel assemblies	A. 2150 kg of U-235 in uranium enriched to no more than 3.15 w/o U-235

B.	Uranium enriched in the U-235 isotope	B.	Fission chambers	B.	60 mg U-235 in uranium at any enrichment
C.	Plutonium-238	C.	Pu-Be neutron source	C.	5 Ci of Pu-238

V. ORGANIZATION

A. Nuclear Criticality Safety and Radiation Protection Responsibilities

1. Station Manager

The Station Manager exercises overall managerial and supervisory responsibilities for the safe operation of the plant and its equipment. He is responsible for compliance with all NRC regulations and license conditions.

2. Superintendent of Operations

The Superintendent of Operations is responsible for receipt, shipment, inspection, handling, and storage of special nuclear materials contained in fuel assemblies. The operations are performed in accordance with approved written procedures.

3. Reactor Engineer

The Reactor Engineer is designated as the Nuclear Fuels Custodian at CNS, Unit 2. Being such, he is responsible for the following activities:

a) Restrict the use of the station's special nuclear materials to locations and purposes authorized by the license(s).

b) Approval of all fuel storage locations and transfers.

c) Maintaining documentation concerning the receipt, shipment, inventory, accidental loss or diversion and transfer of special nuclear materials within the station's purview.

d) Administering physical inventories and performing calculations of element and isotopic inventories onsite.

4. System Health Physicist

The System Health Physicist is responsible for establishing the Health Physics Program for the CNS that is designed to assure compliance with applicable regulations, licenses, and regulatory guides. In addition, he provides technical guidance for conducting this program, audits the effectiveness and the result of the program, and modifies it as required.

5. Station Health Physicist

The Station Health Physicist is designated as the Radiation Protection Manager (RPM) for the site and is responsible for conducting the Health Physics Program for CNS, Unit 2. He has direct access to the Station Manager in matters concerning radiation protection. His duties include the training of personnel in radiation safety, control of radiation exposures of personnel to maintain exposure levels that are as low as reasonably achievable (ALARA), to continuously evaluate and review the radiological status of the CNS, Unit 2, and to make recommendations for the control or elimination of radiation hazards.

B. Minimum Qualifications

In the application, DPC specified the minimum qualifications for the position of Station Health Physicist shall be equivalent to those stated in Regulatory Guide 1.8, "Personnel, Selection, and Training for Radiation Protection Manager." The person presently serving in this capacity at CNS, Unit 2, does not have a degree in science or engineering as required by Regulatory Guide 1.8. Based on a review of the person's prior extensive experience in radiation protection, the NRC staff recommends granting an exemption from the educational requirements for Regulatory Guide 1.8 for the Radiation Protection Manager.

DPC did not commit to the minimum qualifications for CNS, Unit 2, Station Manager, Superintendent of Operations, Reactor Engineer, and System Health Physicist. Accordingly, Conditions 11, 12, 13, and 14 are recommended to specify the minimum qualifications for these positions and shall read as follows:

Condition 11. The minimum technical qualifications for the Station Manager shall be in accordance with Section 4.2.1, "Plant Manager," ANSI N18.1-1971.

Condition 12. The minimum technical qualifications for Superintendent of Operations shall be in accordance with Section 4.3.2, "Supervisors Not Requiring AEC Licenses," ANSI N18.1-1971.

Condition 13. The minimum technical qualifications for Reactor Engineer shall be in accordance with Section 4.4.1, "Reactor Engineering," ANSI N18.1-1971.

Condition 14. The minimum technical qualifications for System Health Physicist shall be in accordance with the requirements for "Radiation Protection Manager," Regulatory Guide 1.8, September 1975.

C. Training

Training is conducted to ensure that all qualified personnel involved in fuel handling participate in a formal training program. The Superintendent

of Operations is responsible for developing and implementing the formal training program. Topics covered in DPC's training program include the basics of radiation, health physics, fire safety, and emergency response. Operations personnel must pass a written exam covering health physics procedures and a fuel handling test using a real assembly under the direction of a qualified individual or a dummy fuel assembly.

The staff has concluded that based on the applicant's radiation safety and fuel handling training programs, the licensee can responsibly carry out the activities for which a license is requested.

D. Administrative Procedures

Administrative procedures for the control and handling of nuclear fuel are reviewed and approved by DPC's operations group. These procedures and any changes to them require review and approval by CNS, Unit 2, Superintendent of Operations or equivalent qualified designee.

VI. NUCLEAR CRITICALITY SAFETY

DPC requests authorization to store fuel assemblies in their shipping containers in the fuel receiving area, in the New Fuel Storage Vault, and in the Spent Fuel Storage Facility.

A. Fuel Handling

Since DPC did not commit to preoperational testing of all fuel handling equipment related to activities authorized by this license, the staff recommends that the following license condition be added:

Condition 15. All preoperational testing of fuel handling equipment related to activities authorized by this license shall be reviewed and approved by DPC before receipt of fuel onsite. Final review and approval of all preoperational testing of fuel handling equipment shall be required by the Superintendent of Operations or equivalent qualified designee. This includes the testing of the following:

a. New Assembly Handling Fixture,
b. Rod Cluster Control Assembly (RCCA) Handling Fixture,
c. New Fuel Elevator,
d. Spent Fuel Pool Manipulator Crane,
e. Indexing of Spent Fuel Pool Manipulator Crane,
f. Whiting 10 Ton Crane,
g. New Fuel Storage Racks in the New Fuel Storage Vault, and,
h. Spent Fuel Storage Racks in the Spent Fuel Storage Facility.

DPC's application specifies that no more than two fuel assemblies shall be out of their shipping containers or storage racks at one time.

Calculations have indicated that two assemblies could be made critical at optimum conditions of water moderation and reflection; however, one assembly separated from another assembly by ≥12 inches of spacing cannot be made critical under any conditions. Therefore, the staff recommends the following license condition limiting the number of fuel assemblies out of storage and the minimum distance from each other and from all other fuel:

Condition 16a. No more than a total of two fuel assemblies shall be out of approved shipping containers or fuel assembly storage racks at any one time.

b. The minimum edge-to-edge distance between the above two fuel assemblies, the shipping container array, and the storage rack arrays shall be 12 inches.

B. Shipping Containers

The fresh fuel assemblies will be temporarily stored in shipping containers in the fuel receiving area. The shipping containers are authorized for use in accordance with Certificate of Compliance No. 5450. The Certificate of Compliance authorizes the shipment of as many as 60 containers filled with unirradiated fuel assemblies in a single Class III shipment independent of stacking or the degree of water moderation and reflection. DPC requests authorization to store up to 14 shipping containers stacked two high without supports or to stack three high with supports. The NRC staff finds that there is no criticality safety hazard when 14 containers are stored together.

C. New Fuel Storage Vault

The New Fuel Storage Vault has a capacity for 98 fuel assemblies. The facility is a reinforced concrete structure with a floor drain designed to prevent flooding of the facility. The fuel assemblies are stored in fuel storage cells (which are formed by steel tubing) with inner dimensions of 9-inches by 9-inches and walls which are 0.12-inch thick. Each cell will hold one fuel assembly. There are 3 double rows of fuel storage cells which are on 21-inch centers within the double rows. There is a 32-inch aisle between each pair of rows. There are 6 rows of assemblies with 17 assemblies per row (4 storage locations are not utilized).

DPC assumed accident conditions in which the array was immersed in water of varying densities. DPC reported k-effective to be less than or equal to 0.98 when the array of fuel assemblies of the highest enrichment was immersed in mist (optimal moderator). DPC assumed the array contained an infinite number of assemblies, enriched to 3.50 w/o U-235. DPC evaluated the array reactivity with a 16 group neutron cross-section data set utilized in KENO. The NRC staff was able to confirm the nuclear criticality safety of the New Fuel Storage Facility using KENO-5 and a 123 group cross-section data set. The NRC staff determined that, if an infinite

fuel storage array was moderated with water mist at optimum density and enriched up to 3.15 w/o U-235, k-effective would be approximately 0.87. The staff finds that, in this condition, DPC's New Fuel Storage Vault design precludes accidental criticality.

DPC may wrap the fuel assemblies in protective covers to protect them from the environment while in storage. If the covers were sealed at their bottoms, the assemblies could become internally moderated with water while the spaces between assemblies will be occupied only with air. This could occur if the bottoms were closed, the storage area flooded and drained, and water retained in the covers. Large arrays under these conditions may become critical. DPC has stated that procedures require a hole be cut in the covers at the bottom to prevent the postulated accident from occurring. This added precaution taken by DPC to prevent such a situation will be represented in Condition 17 for emphasis.

Condition 17. Fuel assemblies shall be stored in such a manner that water would drain freely from the assemblies in the event of flooding and subsequent draining of the fuel storage area.

D. Spent Fuel Storage Facility

The fuel assemblies in the racks in the Spent Fuel Storage Facility are stored dry in a checkerboard pattern; the four fuel storage locations adjacent to each fuel assembly are vacant. The fuel racks are designed as steel cells with nominal wall thickness of 0.25-inch. The nominal internal cell dimension is 9 inches and the nominal center-to-center spacing is 13.5-inches. It is possible to have mist fill the facility from the fire protection systems (hoses). DPC assumed that all fuel assemblies are enriched to 3.50 w/o U-235 and that the fuel assembly array was infinite in all directions.

DPC used a 16 group cross-section data set in KENO. Under these conditions, fresh fuel assemblies stored in a checkerboard array of infinite dimensions would have a maximum k-effective of less than 0.98. The NRC staff, using 123 group cross sections and KENO-5, calculated a maximum k-effective of 0.82. The NRC assumed uranium enriched to 3.15 w/o occupied all storage locations in the checkerboard array and the array was at the optimum degree of water moderation (in this case, full density water) within and between assemblies. Therfore, the Spent Fuel Storage Facility is safe from an inadvertent criticality when the fresh fuel (enriched up to 3.15 w/o) is stored in a checkerboard pattern.

In the application, DPC did not clearly specify the administrative controls that will be used to provide assurance that the fuel assemblies will not be placed closer together in the Spent Fuel Storage Facility than those in a checkerboard pattern. Therefore, Condition 18 is recommended to provide the required assurance; namely:

Condition 18. New fuel assemblies may be stored in the Spent Fuel Storage Facility subject to the following conditions:

a. The maximum U-235 enrichment shall be 3.15 w/o.
b. The fuel assemblies shall be stored dry in a checkerboard pattern.
c. The Reactor Engineer or equivalent qualified designee shall verify correct fuel assembly location after insertion of each assembly into the assigned storage rack in accordance with a prepared written procedure approved by the Superintendent of Operations or equivalent qualified designee.
d. An independent loading verification shall be made by a Quality Control Inspector.
e. The Reactor Engineer or equivalent qualified designee and the Quality Control Inspector shall each sign a document assuring proper storage of each fuel assembly.

E. Exemption from Criticality Alarm Requirements

DPC has requested, pursuant to 10 CFR 70.24(d), an exemption from the provisions of 10 CFR 70.24. Because of the inherent features associated with the storage and inspection of unirradiated fuel containing uranium enriched to less than 5 percent in the U-235 isotope when no fuel processing activities are to be performed and the inherent features in handling limited quantities of other radioactive materials, the staff hereby determines that granting such an exemption is authorized by law, will not endanger life or property, or the common defense and security and is otherwise in the public interest. This exemption is authorized pursuant to 10 CFR 70.24. It is recommended that the exemption be identified as Condition 19.

Condition 19. DPC is hereby exempted from the provisions of 10 CFR 70.24 insofar as this section applies to materials held under this license.

VII. RADIATION SAFETY

DPC is committed, consistent with the recommendation of Regulatory Guide 8.8, to establishing a program to maintain occupational and general public exposures as low as reasonably achievable (ALARA). It is the responsibility of the Station Health Physicist to implement the established radiation safety program to attain this goal. The System Health Physicist will periodically audit the effectiveness and adequacy of such a program.

Since all radioactive material, including fresh fuel assemblies, are sealed sources, the principal exposure pathway to an individual is via external radiation. For a low-enriched uranium fuel bundle (<4% U-235 enrichment), the exposure rate at 1 foot from the surface is normally less than 1 mr/hr; therefore, it is estimated that the exposure level to workers from these sources would be less than 25 percent of the maximum permissible exposure specified in 10 CFR Part 20. All other special nuclear materials requested by the licensee will also represent no threat to plant personnel or to the environment because of the small quantities of radioactive material involved.

At CNS, Unit 2, all persons subject to occupational radiation exposures will be monitored in accordance with 10 CFR 20.202. This is done by using TLD dosimeters and self-reading dosimeters. Individual exposures will be evaluated daily from self-reading dosimeters and monthly TLDs, in accordance with guidance in Regulatory Guide 8.14, "Personnel Neutron Dosimeter." An administrative limit of 1.0 rem per quarter for personnel has been established to ensure that the regulatory limits are not exceeded.

Storage of other radioactive materials (fission chambers and a Pu-Be neutron source) will be in a locked storage area. Access to these special nuclear materials shall be under the authority and control of the CNS, Unit 2, Station Health Physicist.

Annex A, "License Condition for Leak Testing Sealed Plutonium Sources," has been adopted as a Branch Technical Position and will be incorporated as License Condition 20. Accordingly, Condition 20 shall read as follows:

> Condition 20. DPC shall comply with provisions of Annex A, "License Condition for Leak Testing Sealed Plutonium Sources."

Because of the low-radiation exposure levels associated with the requested materials and activities and DPC's radiation protection procedures, the staff has concluded that the requested operation can be carried out with adequate protection of the operating personnel.

VIII. ENVIRONMENTAL PROTECTION

The NRC has prepared an Environmental Assessment related to the proposed 10 CFR Part 70 Fuel Storage License for CNS, Unit 2. Based on this assessment, a Finding of No Significant Impact has been issued and approved pursuant to 10 CFR Part 51. This finding was published in the Federal Register on April 30, 1985.

IX. FIRE SAFETY

The materials used in the fuel storage areas are steel and concrete. There is a manual fire fighting system in the New Fuel Storage Vault area. All extinguishers are of the dry chemical or CO_2 type and the area is normally free of combustible material.

The Spent Fuel Storage Facility is protected from fire by two hoses and stations to extinguish fires in the area (including the fuel receiving area). Dry chemical or CO_2 extinguishers are also provided. DPC has administrative controls that prohibit fire fighting crews from spraying water into the Spent Fuel Storage Facility or fuel receiving areas if new fuel is being transferred from its shipping container to its storage location. The staff has determined that the fire protection measures taken by DPC are adequate for the protection of the health and safety of the workers and the public under this license.

X. PHYSICAL PROTECTION

The Division of Safeguards, NMSS, has reviewed DPC's Physical Security Plan and has determined that it meets the requirements of 10 CFR 73.67. To ensure

that the Physical Security Plan shall be fully implemented and remain in effect whenever fresh fuel is stored onsite, the staff recommends Condition 21.

Condition 21.

DPC shall maintain and fully implement all provisions of the Commission approved Physical Security Plan, including any changes made pursuant to the authority of 10 CFR 70.32(e). The approved Physical Security Plan consists of DPC's initially submitted Plan titled, "Catawba Nuclear Station (Unit 2) SNM of Low Strategic Significance Storage and In-Transit Security Plan," dated April 26, 1985, and as amended by Attachment 1 to DPC's letter dated June 19, 1985. The Physical Security Plan identified by this condition shall be withheld from public disclosure pursuant to 10 CFR 2.790(d).

XI. CONCLUSIONS

1. After reviewing the application and its supplement, the staff finds that:

   a. DPC meets the requirements of the Atomic Energy Act, as amended, and of the regulations of the Commission,

   b. Issuance of the license would not be inimical to the common defense and security, and

   c. Issuance of the license would not constitute an unreasonable risk to the health and safety of the public.

2. With the recommended license conditions the NRC staff finds that:

   a. DPC is qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in 10 CFR 70.

   b. DPC's proposed equipment and facilities are adequate to protect health and minimize danger to life or property.

   c. DPC's proposed procedures to protect health and to minimize danger to life or property are adequate.

XII. RECOMMENDATIONS

The staff recommends approval of the application and its supplement subject to the following conditions which the staff finds are appropriate to protect health or to minimize danger to life or property.

Condition 11. The minimum technical qualifications for the Station Manager shall be in accordance with Section 4.2.1, "Plant Manager," ANSI N18.1-1971.

Condition 12. The minimum technical qualifications for Superintendent of Operations shall be in accordance with Section 4.3.2, "Supervisors Not Requiring AEC Licenses," ANSI N18.1-1971.

Condition 13. The minimum technical qualifications for Reactor Engineer shall be in accordance with Section 4.4.1, "Reactor Engineering," ANSI N18.1-1971.

Condition 14. The minimum technical qualifications for System Health Physicist shall be in accordance with the requirements for "Radiation Protection Manager," Regulatory Guide 1.8, September 1975.

Condition 15. All preoperational testing of fuel handling equipment related to activities authorized by this license shall be reviewed and approved by DPC before receipt of fuel onsite. Final review and approval of all preoperational testing of fuel handling equipment shall be required by the Superintendent of Operations or equivalent qualified designee. This includes testing of the following:

a. New Assembly Handling Fixture,
b. Rod Cluster Control Assembly (RCCA) Handling Fixture,
c. New Fuel Elevator,
d. Spent Fuel Pool Manipulator Crane,
e. Indexing of Spent Fuel Pool Manipulator Crane,
f. Whiting 10 Ton Crane,
g. New Fuel Storage Racks in the New Fuel Storage Vault, and
h. Spent Fuel Storage Racks in the Spent Fuel Storage Facility.

Condition 16. a. No more than a total of two fuel assemblies shall be out of approved shipping containers or fuel assembly storage racks at any one time.

b. The minimum edge-to-edge distance between the above two fuel assemblies, the shipping container array, and the storage rack arrays shall be 12 inches.

Condition 17. Fuel assemblies shall be stored in such a manner that water would drain freely from the assemblies in the event of flooding and subsequent draining of the fuel storage area.

Condition 18. New fuel assemblies may be stored in the Spent Fuel Storage Facility subject to the following conditions:

a. The maximum U-235 enrichment shall be 3.15 w/o.
b. The fuel assemblies shall be stored dry in a checkerboard pattern.
c. The Reactor Engineer or equivalent qualified designee shall verify correct fuel assembly location after insertion of each assembly into the assigned storage rack in accordance with a prepared written procedure approved by the Superintendent of Operations or equivalent qualified designee.
d. An independent loading verification shall be made by a Quality Control Inspector.

e. The Reactor Engineer or equivalent qualified designee and the Quality Control Inspector shall each sign a document assuring proper storage of each fuel assembly.

Condition 19. DPC is hereby exempted from the provisions of 10 CFR 70.24 insofar as this section applies to materials held under this license.

Condition 20. DPC shall comply with provisions of Annex A, "License Condition for Leak Testing Sealed Plutonium Sources."

Condition 21. DPC shall maintain and fully implement all provisions of the Commission approved Physical Security Plan, including any changes made pursuant to the authority of 10 CFR 70.32(e). The approved Physical Security Plan consists of DPC's initially submitted Plan titled, "Catawba Nuclear Station (Unit 2) SNM of Low Strategic Significance Storage and In-Transit Security Plan," dated April 26, 1985, and as amended by Attachment 1 to DPC's letter dated June 19, 1985. The Physical Security Plan identified by this condition shall be withheld from public disclosure pursuant to 10 CFR 2.790(d).

Original signed by:
Kishore Kodali

Kishore K. Kodali
Uranium Process Licensing Section
Uranium Fuel Licensing Branch
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Original Signed By:
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