Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

September 30, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Braidwood Station Units 1 and 2
Response to Unresolved Issues Contained
In Draft SER-NUREG 1002
NRC Docket Nos. 50-456/457

Reference (a): B. J. Youngblood letter to D. L. Farrar
dated July 15, 1983

Dear Mr. Denton:

Reference (a) provided the Commonwealth Edison Company with the Draft SER-NUREG 1002 for our Braidwood Station and requested our written response to the unresolved issues by October 1, 1983. The purpose of this letter is to provide our response to the various open items to the extent possible at this time.

It should be noted that some of the open items cannot be resolved at this time as they involve future NRC Staff site audits. Additionally, our final Braidwood Station position concerning certain items is dependent on the requisite Byron Station resolution, and is therefore premature at this time to resolve such issues. We have indicated the above status in the Attachments where applicable. We are additionally providing editorial and factual corrections where necessary.

Please address any questions that you or your staff may have concerning this matter to this office.

One (1) signed original and fifteen (15) copies of this letter with Attachments are provided for your use. Additionally, one (1) copy is being sent directly to Ms. Janice A. Stevens.

Very truly yours,

E. Douglas Swartz

E. Douglas Swartz
Nuclear Licensing Administrator

Attachment
cc: J. A. Stevens - LBI
J. G. Keppler - RIII
RIII Inspector - Braidwood
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Commonwealth Edison Company
Response to the Open Items Contained in the Braidwood
Draft SER-NUREG 1002 dated July 15, 1983

Attachment A	Outstanding Items - Part A Items
Attachment B	Confirmatory Issues - Part A Items
Attachment C	License Conditions - Part A Items
Attachment D	Miscellaneous Editorial and Factual Corrections

ATTACHMENT A
Outstanding Items - Part A Items

(1) Meteorological Data - Section 2.3

Response:

Improved meteorological data was provided for the period of 1979 through 1982. The magnetic tape containing this data was formally transmitted to the NRC Staff. See the J. C. Golden letter to James Hawxhurst dated July 22, 1983 for reference.

(2) Site Drainage - Section 2.4.4.3

Response:

A revised analysis of site drainage in FSAR Section 2.4.2.3 has been performed and is attached. This attachment will be included in Amendment No. 44 to the FSAR.

(3) Backfill Material Specifications - Section 2.5.4.3

Response:

A revision to Question No. 241.3 has been provided in Amendment No. 43 to the FSAR to address this issue. A copy of same is attached for convenient reference.

(4) Pump and Valve Operability - Section 3.9.3.2*

Response:

This item requires an NRC Staff site audit in order to resolve this item. We believe that the necessary information for the selection of equipment for the site audit has been provided in Table 3.9-15 in FSAR Amendment 22 and Table 3.9-16 in FSAR Amendment 39 that provide a listing of "active pumps" and "active valves" respectively. The Draft SER should be revised to reflect this. Additionally, the equipment documentation that was reviewed during PVORT Audit at Byron Station is equally applicable to Braidwood Station. Therefore, the scope of the Braidwood Station PVORT Audit should be significantly reduced.

(5) Seismic and Dynamic Qualification of Equipment - Section 3.10*

Response:

This item requires an NRC Staff site audit in order to resolve this item. This audit requires 85% of the equipment installed. Therefore, the necessary information will be supplied when the equipment installation approaches the requisite percent

completion. However, the qualification documentation for equipment that was reviewed during the SQRT Audit at Byron Station is equally applicable to Braidwood Station. Therefore, the scope of the Braidwood Station SQRT audit should be significantly reduced.

(6) Reactor Vessel Material and Pressurized Thermal Shock - Section 5.3

Response:

A revision to Question No. 251.2 has been provided in Amendment No. 43 to the FSAR to provide the Braidwood Reactor Vessel material properties. A copy of same is attached for convenient reference. It should be noted that the FSAR Chapter 16.3/4 and 16.B3/4 currently contains the reactor vessel material data and plant specific data concerning end-of-life (EOL) RT_{NDT} for the Braidwood Unit 1 and 2 reactor vessels. It would appear that the requested information was submitted in FSAR Amendment Nos. 21, 23 and 38.

(7) Containment Pressure Boundary Components - Section 6.2.7

Response:

This item will be responded to at a later date.

(8) Radiation Protection Manager (RPM) - Section 12.5.1

Response:

A meeting was held with the NRR Staff at the Braidwood Station on September 13, 1983 to discuss the NRC concerns with our commitments to training and qualification of the RPM. Revised commitments for the Braidwood Station RPM are attached that reflect the agreements reached during the site meeting.

(9) Emergency Preparedness Plans and Facilities - Section 13.3*

Response:

The Emergency Response Facilities for Braidwood Station are described in the FSAR and in the Commonwealth Edison Company responses to NUREG 0737 Supplement No. 1. As stated in our response to Question 7.1.11 in Amendment No. 2 to the ER dated July 1983, we expect to complete a new evacuation time study in December 1983 utilizing present standards and updated population data.

(10) Administrative Procedures - Section 13.5.1

Response:

The Braidwood Station procedures that will be employed concerning crane operations fall under the general topic of Maintenance Procedures. The crane operating procedures have been extensively discussed in the Byron and Braidwood Station Phase I and Phase II Heavy Load submittals in response to NUREG 0612. Therefore, we do not believe that FSAR Section 13.5.1 need be revised to include a description of the procedures to be employed concerning crane operations.

The Braidwood Administrative Procedures that will be developed will utilize the key points of the Byron Administrative Procedures (BAP) as a basis. Concerning BAP 200-1 (Station Position Descriptions) and BAP 300-8 (Operating Experience Feedback), similar procedures will be developed for Braidwood Station.

(11) Procedures Generation Package (PGP) - Section 13.5.2

Response:

The Commonwealth Edison Company commitments to NUREG 0737 Supplement No. 1 which includes the Procedures Generation Package (PGP) commitments are documented in the following references:

a) Cordell Reed letter to H. R. Denton dated April 14, 1983

b) E. D. Swartz letter to H. R. Denton dated July 20, 1983

c) Cordell Reed letter to H. R. Denton dated July 28, 1983

d) Cordell Reed letter to H. R. Denton dated August 25, 1983

The technical and schedular issues are under current negotiation with the NRR Staff for all CECo. stations, and a final submittal is anticipated. It is our understanding that the negotiations have not taken issue with the CECo. commitments to submit the PGP based upon Revision 1 to the Westinghouse OG EPGs for Braidwood Station one (1) year after NRR Staff approval of Revision 1.

(12) Steam Generator Tube Failure - Section 15.4.3

Response:

This item is currently being resolved for Byron Station and such resolution will be applicable to Braidwood Station. We do not consider this item to be Braidwood site-specific as indicated on Page 1-14 of the Draft SER.

(13) Human Factors Engineering - Section 18*

Response:

The Draft SER statement that "There is currently insufficient information to prepare a human engineering evaluation of the Braidwood Control Room" is misleading and should be removed. The majority of the Braidwood Station control room is identical to that of Byron Station. Based on the "duplicate plant concept", the Preliminary Design Assessment (PDA) that was performed on Byron Station and audited and reviewed by the NRC Staff, is applicable to Braidwood Station with minor exceptions. Therefore, the Braidwood PDA is complete except for the minor plant differences as follows.

The Braidwood Station Unit 1 and the Byron Station Unit 1 Control Room and Control Panels are identical except for the minor differences due to the different heat sink and the different high voltage transmission facilities used at each site. Specific site differences are:

1) Panel 1PM01J has minor differences due to the different power configuration supplying Braidwood's Lake Screen House and Byron's River Screen House.

2) Panel 1PM03J has minor differences due to the Circulating Water System differences between the two sites.

3) Panel 0PM01J and 0PM02J differences due to Service Water System and Cooling Tower/Cooling Lake differences.

4) Panel 0PM03J differences due to the different off-site transmission facilities.

5) Panel 1PM09J differences due to slight Fire Protection Alarm Panel differences.

The resolution of the Byron Station PDA and associated fixes will be applicable to Braidwood Station. A PDA will be performed on the site-specific items and the requisiste report will be provided for NRC Staff review no later than 120 days prior to OL issuance.

ATTACHMENT B
Confirmatory Issues - Part A Items

(1) Foundation Stability Data - Section 2.5.4.5

Response:

A revision to Question No. 362.1 has been provided in Amendment No. 43 to the FSAR to address this issue. A copy of same is attached for convenient reference. A commitment has been made for the operational phase settlement monitoring of the Lake Screen House.

(2) Piping Vibration Test Program - Section 3.9.2.1*

Response:

Braidwood Station will implement the preoperational vibration testing program discussed in the Byron SER. Additionally, the snubber pre-service inspection program submitted by T. R. Tramm to H. R. Denton dated March 19, 1982 is applicable to Braidwood Station.

(3) Preservice Inspection Program - Section 5.2.4, 6.6*

Response:

A conference call was held on June 14, 1983 with Mr. Martin Hum of the Materials Engineering Branch to discuss this matter. The following documents the discussions concerning the Braidwood Preservice Inspection and provides additional information.

a) The Preservice Inspection NDE Programs for Braidwood Units 1 and 2 will be conceptually identical to the Byron Unit 1 NDE Program. The Byron Program Plan Tables with various notes and relief requests were previously docketed. See T. R. Tramm letter to H. R. Denton dated March 1, 1983 for reference. All examinations will be performed to the requirements of ASME Section XI 1977 Edition with addenda through the Summer 1978 Addenda. Commonwealth Edison Company procedures will be used and examinations will be performed by Commonwealth Edison Company employees. Examinations began on Braidwood Unit 1 systems in June, 1983 and will be completed prior to Unit 1 Fuel Load. A draft Braidwood Unit 1 NDE Program Plan is scheduled to be complete by December 1983. Relief requests will be provided on a periodic basis as they are identified until all examinations are complete.

b) Eddy current examinations will be performed on 100% of the tubes in all steam generators. Bids from various vendors are currenly being reviewed for this work scope and examinations are scheduled to begin on Braidwood Unit 1 in December 1983. Unit 2 examinations will begin immediately upon completion of Unit 1 examinations.

c) The automated reactor vessel examinations for Braidwood Units 1 and 2 will also be contracted. Bids are currently being reviewed and examinations are now scheduled to begin on Unit 1 in December, 1983. Examinations on Unit 2 will immediately begin following the completion of the Unit 1 examinations. A best effort will be made to meet the intent of the requirements of Regulatory Guide 1.150 Revision 1. Any necessary relief requests will be submitted after the completion of the examinations.

Additionally, it is premature at this time to address the concerns of Questions 121.5 and 121.6. However, the Braidwood response to Question 121.7 was provided in Amendment No. 42 dated May 1983.

(4) Viewing the Installation and Arrangement of Electrical Equipment - Section 8.1*

Response:

This item requires an NRC Staff site audit in order to resolve this item. However, the site audit of Byron Station held on May 26 and 27, 1983 by the I&C Branch reviewed items generic to both Byron and Braidwood Stations and should therefore be applicable to Braidwood Station. The scope of the Braidwood I&C Audit should be signficantly reduced.

This Confirmatory Item (4) should reference the Byron SER "Section 7.1" and not "Section 8.1" as stated in Draft SER.

(5) Electrical Distribution System Voltage Verification - Section 8.2.4*

Response:

Braidwood Station will verify and document final voltage levels. A revision to Question No. 40.176 will be provided in Amendment No. 44 to include the results of the Braidwood Station preliminary voltage study currently in progress.

(6) Revision to Physical Security Plan - Section 13.6

Response:

The Commonwealth Edison Company received a request for additional information concerning the Braidwood Station Physical Security Plan, B. J. Youngblood letter to D. L. Farrar dated August 3, 1983. The requested information was formally transmitted. See the D. L. Farrar letter to H. R. Denton dated September 19, 1983 for reference. It is our understanding that NRR Staff acceptance of our submittal will resolve this matter.

ATTACHMENT C
License Conditions - Part A Items

(1) Inservice Inspection Program - Section 5.2.4, 6.6*

Response:

It is too premature to resolve this item. The Braidwood Station ISI Program will be submitted six (6) months prior to commercial service.

(2) Response Time Testing - Section 7.2.2.5*

Response:

Westinghouse provided the NRC with a report entitled "The Use of Process Noise Measurements to Determine Response Characteristics of Protection Sensors in U.S. Plants" dated August 1983 to justify the method of response time testing stated in Section 7.2.2.5 of the Byron SER. It is our hope that the NRC Staff will review and approve this Westinghouse Topical Report prior to the issuance of the Byron Operating License. See the E. P. Rahe letter to D. G. Eisenhut dated August 15, 1983 for reference. Braidwood Station intends to utilize the same computer based system as that proposed for Byron Station.

(3) Steam Valve Inservice Inspection - Section 10.2, 10.4.2*

Response:

The resolution of this item concerning steam valve inspection for Byron Station will be applicable to Braidwood Station.

(4) Implementation of Secondary Water Chemistry Monitoring and Control Program as Proposed by the Byron/Braidwood FSAR - Section 10.3.3*

Response:

The Braidwood Station Secondary Water Chemistry Monitoring and Control Program currently described in the FSAR will be implemented.

(5) Personnel on Shift with Previous Commerical PWR Experience During Startup Phase - Section 13.1.2.1*

Response:

Figure 13.1-1 has been revised to reflect the current Project Management Organization and has been provided in Amendment No. 43 to the FSAR. A copy of same is attached for convenient reference. The current revision of the Commonwealth Edison Company QA Topical Report CE-1A is Revision No. 25.
The Braidwood Station organization is described on the attached Figure 13.1. Reporting directly to the Station Superintendent are the Maintenance Assistant Superintendent, the Operating Assistant Superintendent, the Administrative and Support Services Assistant Superintendent, and the Personnel Administrator. The Site Quality Assurance Group is independent (not shown on Figure 13.1) of the operating organization and reports directly to the Director of Quality Assurance (Operations) offsite as described in Topical Report CE-1A, Revision 25. The plant staff presently consists of about 246 individuals with a projected number of 500 individuals by the Unit 1 fuel load date.

Concerning this License Condition (5) and the question of shift manning, Braidwood Station will meet the licensed operator staffing requirements described in the Final Rule 10 CFR 50.54(m)(2). We believe that such a license condition concerning previous commercial PWR experience is site specific and that an NRC Staff review of qualifications/resumes is necessary prior to reaching any such conclusions for Braidwood Station.

(6) Natural Circulation Testing - Section 5.4.3*

Response:

The satisfactory resolution of this item for Byron Station should result in comparative test data to evaluate the natural circulation capabilities of Braidwood Station.

ATTACHMENT D

Miscellaneous Editorial and Factual Corrections

Pages 1-10 1-11	Section 1.4	The list of consultants appears to be the one from Byron. Equitable Environmental Health, Inc., did not do any environmental studies at Braidwood and Espey, Huston and Associates' involvement was minimal. Terrestrial and aquatic monitoring for the baseline was done by Westinghouse Environmental Systems. For the construction and preoperational phases, the principal consultants were the Illinois Natural History Survey for Aquatic and Dr. Barry Jacobsen for terrestrial investigations associated with annual infrared photographs by Aero-Metric Engineering, Inc. All archeological investigations assoicated with Braidwood were done by the Illinois State Museum Society. The University of Wisconsin-Milwaukee did most of the Byron investigations.
Page 2-1	Section 2.1.1	The site size is 4,454 acres rather than 4,320. Joliet 1980 population is 77,956 rather than 78,165. Kankakee 1980 population is 30,141 rather than 29,812. The cooling pond size is 2,537 acres rather than 2,475.
Page 2-2	Section 2.1.2	The minimum exclusion area boundary distance is 1625 ft. (measured from gaseous release point). The SER shows 1,500 ft. from the outer containment wall.
Page 2-7	Section 2.4.2	The cooling pond size is 2,537 acres rather than 2,640.
Page 2-8	Section 2.4.3	The cooling pond surface area is 3.96 square miles rather than 3.87.

Page 2-9	Line 5	Revise the sentence "the Mazon River (a tributary to the Kankakee River)..." to read as "the Mazon River (a tributary to the Illinois River)..."
Page 2-10	Paragraph 5	SRP 2.4.2 (dated July 1981) does not indicate that the new references HMR 51 and 52 have to be used in the site drainage analysis. However, a revision of FSAR section on site drainage has been prepared.
Page 2-12	Section 2.4.5	The cooling pond size is 2,537 acres rather than 2,475.
Page 2-15	Paragraph 5	Revise the typographical error 7.32 (10^{-2}) CM/sec to 7.37 (10^{-2}) CM/sec.
Page 2-22	Section 2.5.1.3	Strip mining for coal continued until 1974 or 1975 rather than 1954.
Page 2-47	Figure 2.2	The site boundary lines and the route of the makeup - blowdown lines are incorrect.
Page 13-2	Section 13.4.2	The statement that "The Manager of Quality Assurance reports directly to the Chairman and President of Commonwealth Edison" is incorrect. The Manager of Quality Assurance reports to the Vice Chairman who in turn reports to the Chairman and President.
Pages 13-1 13-2 13-4	Various	The current revision of the CECo. QA Topical Report is Revision 25 dated September 9, 1983.

7329N

adjusted to the Wilmington site by multiplying the Custer Park discharge by the ratio of the square roots of the drainage areas.

The maximum known discharge near Wilmington, 75,900 cfs, occurred July 13, 1957. Its corresponding gauge height was 11.40 feet above datum. The maximum stage during the period of record was 13.88 feet, caused by ice jams. Ice jam floods in 1883 and 1887 reached a stage of 16.73 feet, for which the discharge is not known. All maximum stages greater than those due to floods were caused by ice jams. Of the 36 years for which maximum water surface elevations are known, 18 maximums were caused by ice jams as high as almost 7 feet above the year's highest flood stage (see Subsection 2.4.7).

2.4.2.2 Flood Design Considerations

The plant main floor is located at elevation 601.0 feet, which is above all flood levels from nearby rivers, streams, and reservoirs. The cooling pond dike system is higher than the calculated flood elevation with coincident wind wave action. The probable maximum precipitation (PMP) water surface elevation of the pond is below safety-related facilities. Floods occurring on the Kankakee River could affect only the river screen house, which is a non-safety-related structure supplying makeup water to the cooling pond. Other streams in the area pose no flood threat to safety-related items. The site drainage system has been designed to pass rainfall without flooding.

There are no dams upstream on nearby rivers whose failure could cause flooding at the site. The general terrain of the area is flat, with no location at which landslides could cause flood waves at the site.

The controlling event for flooding at the site is the probable maximum flood for the cooling pond (see Subsection 2.4.8.2). This event has been analyzed by applying the local probable maximum precipitation (PMP) to the pond watershed following an antecedent storm equivalent to one-half the PMP (see Subsection 2.4.8.2.4).

2.4.2.3 Effects of Local Intense Precipitation

Site grading and drainage are designed to assure that the local PMP will have no effect on safety-related facilities. The layout of roads, tracks, and drainage in the immediate plant area is shown in Figure 2.4-7.

PMP data are taken from Hydrometeorological Report No. 33 (Reference 2) and is estimated to amount to 31.9 inches over a 48-hour period. This is the summer PMP, which is greater than the largest winter PMP coincident with the water equivalent of the 100-year snow pack. The PMP time distribution in 6-hour and 1-hour periods is given in Tables 2.4-2 and 2.4-3.

The roofs of all safety-related structures are designed to withstand the higher of the loads caused by the 24-hour all-season PMP or the 100-year maximum snow pack combined with the winter PMP of 48-hour duration at the plant site.

Postulating that the roof drains get clogged at the time of PMP, the maximum accumulation of water on the roofs of safety-related structures will be up to the height of the parapet walls plus the depth of overflow over the parapet wall. The height of the parapet walls is 1 foot 4 inches. The maximum depth of overflow is estimated to be 2.0 inches. Therefore, the corresponding water load due to summer PMP on the roofs will be 93.6 lb/ft^2. The maximum 48-hour winter PMP at the site is 14.7 inches in March (Reference 2). The snow load at the site corresponding to a 100-year mean recurrence interval is 28 lb/ft^2. Due to the 1-foot 4-inch high parapet walls, accumulation of the entire winter PMP with the above snow load is not possible on the roofs, and the excess precipitation overflows the parapet. Therefore, the governing roof load is 93.6 lb/ft^2. However, as explained in Subsection 3.8.4, the roofs of all safety-related structures are designed for a load of 104 lb/ft^2.

The plant grade elevation is 600.0 feet and the grade floors of the safety-related buildings are at elevation 601.0 feet.

The site drainage system is designed to follow the natural drainage pattern and to drain the storm water away from the plant area. The areas surrounding the plant buildings are graded to direct the surface runoff towards north, west, and east of the plant area.

For the analysis of local intense precipitation, the 1-hour PMP on 1 square mile area for the site is taken from the Hydrometeorological Report No. 52 (Reference 2c). This PMP was derived from 6-hour, 10-square mile PMP values given in Hydrometeorological Report No. 51 (Reference 2b), and is considered point rainfall value. This 1-hour 1-square mile PMP is distributed into values for smaller durations following procedures given in Reference 2c. The magnitude and intensity of these smaller duration rainfalls are presented in Table 2.4-4.

The runoff from local intense precipitation that can contribute to potential flooding of the plant area is from the areas shown in Figure 2.4-7a. The probable maximum precipitation falling on this area was considered in the analysis of local intense precipitation on the plant site. The peripheral roads and railroads will act as weirs to pass the resulting runoff, in the event of a PMP at the plant site.

It was conservatively assumed in the analysis that the site drainage system would not be functioning at the time of the PMP. The rational formula was used in estimating the peak runoff from the area. The rational formula is given by:

$$Q = CIA, \text{ where}$$

Q = peak runoff (cfs)

C = coefficient of runoff

I = intensity of rainfall (inches/hour)

A = drainage area (acres).

The coefficient of runoff was estimated by using a weighted average of the values obtained for the building roofs, roads, graded and other areas (Reference 2a). The time of concentration was computed from Kirpich's formula (Reference 2a). The intensity of rainfall corresponding ot a time of concentration was interpolated from Table 2.4-4. The water surface elevation was estimated for peak flow over the peripheral roads and railroads using a broad crested weir formula with a coefficient of discharge of 2.7.

The plant site area is divided into Zones A, B, C, and D as shown in Figure 2.4-7a.

The storm water, which accumulates in Zone A, flows over two peripheral roads southwest of the plant buildings. The overflow length of the road is approximately 160 feet at elevation 600.0 feet. The area of Zone A is 13.1 acres. The weighted runoff coefficient is estimated as 0.69 and the time of concentration is 16 minutes. The peak runoff from Zone A is 331 cfs, which will flow over the peripheral road and would produce a water surface elevation near the plant buildings of 600.84 feet. If the value of runoff coefficient is conservatively assumed to be 1, the peak runoff from Zone A would be 480 cfs, with a water surface elevation of 601.07 feet near the plant buildings.

The runoff from Zone B flows over railroad track 1 on the east, and over track 4 on the north. The total overflow length as shown in Figure 2.4-7a is 1,650 feet, and the top of the rail is at elevation 601.0 fet for these two tracks. The area of Zone B is 27.3 acres. An estimated runoff coefficient of 0.63 was used, with a time of concentration of 20 minutes. The peak runoff from Zone B is 580 cfs, which will flow over the peripheral railroad and produce a water surface elevation of 601.26 feet near the plant buildings. If the value of the runoff coefficient is conservatively assumed to be 1, the peak runoff from Zone B would be 920 cfs, with a water surface elevation of 601.35 feet.

Zone C has an area of 6.43 acres and the runoff from this zone will flow over the peripheral road on the north and west, and hence, will not affect the safety-related facilities.

The runoff from Zone D flows over the peripheral road and railroad track 1 towards the south, east, and west. The drainage area of Zone D is 14.8 acres. The estimated runoff from this area due to local intense precipitation is 334 cfs with a runoff coefficient of 0.67 and a time of concentration of 20 minutes. An overflow length of 1,800 feet on the south and east was only considered to be conservative. The top of rail and road elevation is 601.0 feet, and the maximum water level due to an overflow of 334 cfs would be 601.17 feet. If the runoff coefficient of 1 is conservatively assumed, the peak runoff from Zone D would be 499 cfs, with a maximum water level of 601.22 feet near the plant buildings.

The proposed security fence around the plant buildings has the top of concrete footing at the grade elevation and, hence, will not affect the water levels estimated in the foregoing analysis.

It can be seen from the foregoing analysis that the water level in the area adjacent to the plant buildings can reach an extreme elevation of 601.35 feet, which is 0.35 foot above the grade floor level.

This occurs for a short period of time until the runoff due to the PMP is discharged from the plant site over the roads and railraods and the drainage system. To prevent this water from entering areas where essential equipment/systems are located, reinforced concrete curbs are provided.

2.4.3 Probable Maximum Floods on Streams and Rivers

The probable maximum flood (PMF) is defined by the Corps of Engineers as the hypothetical flood characteristics that are considered to be the most severe reasonably possible at a particular location, based on relatively comprehensive hydrometeorological analysis of critical runoff-producing precipitation and hydrologic factors favorable for maximum flood runoff.

PMF elevations were calculated for the Kankakee River, Mazon River, Granary Creek downstream from Crane Creek, and the cooling pond. The Kankakee River PMF elevation at the river screen house and elevations for other streams near the site are calculated and described in the following paragraphs. The cooling pond PMF is evaluated in Subsection 2.4.8.2. These locations and water levels are summarized in Table 2.4-5 along with the low, average annual, and flood-of-record flow elevations for the Kankakee River at the intake. As shown in the following subsections, none of the stream floods would have any effect on the plant safety-related systems.

2.4.10 Flooding Protection Requirements

The PMF design bases for the flood protection requirements on the Kankakee and Mazon Rivers and Crane and Granary Creeks are discussed in Subsection 2.4.3. The cooling pond PMF design basis is explained in Subsection 2.4.8.2. The design basis for flooding effects due to the local PMP is discussed in Subsection 2.4.2. The flood elevations resulting from any of these extreme events would have no effect on safety-related facilities.

Floods on the Kankakee River could affect the River Screen House, a non-safety-related structure. The PMF on the Kankakee River could not affect the site, since the maximum water surface elevation would be a minimum of 38 feet below the plant grade elevation of 600 feet. Maximum water surface elevations under PMF conditions for the Mazon River and Granary Creek are 582 feet and 576 feet respectively, still well below the plant grade.

Floods resulting from the local PMP could result in a short-term maximum water surface elevation of 601.35 feet in the immediate plant area. As described in Subsection 2.4.2.3 the essential equipment/systems are protected from the local PMP by the provision of reinforced concrete curbs.

The maximum water surface elevation in the cooling pond resulting from the PMF with antecedent SPF is 598.17 feet. The cooling pond dike elevation is 600 feet, except for that area south of the plant where the dike elevation is 602.5 feet. The dike is maintained at a higher elevation in this area to prevent splashover resulting from possible runup to elevation 602.34 feet (Subsection 2.4.8.2.6).

The slopes of the dikes are protected with riprap designed using procedures defined in Reference 13. The pondside slopes are designed to withstand conditions resulting from the PMF with antecedent SPF and 40-mph wind as discussed in Subsection 2.4.8.2.6. Downstream slopes are protected against erosion by seeding. The slope stability analysis for the dikes is presented in Subsection 2.5.6.

2.4.11 Low Water Considerations

2.4.11.1 Low Flow in Rivers

Low flows in the Kankakee River cannot affect safety-related facilities of the plant, since the ultimate heat sink is independent of flows in the river. Low flow elevations in the Kankakee River at the site are controlled by a rock ledge across the river between Resthaven and Lakewood Shores, 7700 feet upstream of the Wilmington dam. The ledge acts like a dam by creating a pool of water that reaches upstream to Custer Park, approximately 1 mile upstream from the intake. Under low flow

TABLE 2.4-4

MAXIMUM RAINFALL INTENSITY DURING LOCAL PROBABLE MAXIMUM PRECIPITATION

TIME (minutes)	CUMULATIVE RAINFALL (inches)	RAINFALL INTENSITY (inches per hour)
5	5.98	71.8
15	9.47	37.9
30	13.56	27.1
60	17.8	17.8

2.4.15 References

2.4.15.1 References Cited in Text

1. Barker, Carlisle, and Nyberg, Kankakee River Basin Study, Illinois Division of Waterways, Springfield, Illinois, 1967.

2. Riedel, Appleby, and Schloemer, Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours, Hydrometeorological Report No. 33, Weather Bureau and Corps of Engineers, Washington, D. C., April 1956.

2a. V. T. Chow, Handbook of Applied Hydrology, McGraw-Hill Book Company, New York, 1964.

2b. L. C. Schreiner, and J. T. Riedel, Probable Maximum Precipitation Estimates, United States East of the 105th Meridian, Hydrometeorological Report No. 51, National Weather Service and U. S. Army Corps of Engineers, Silver Spring, MD, June 1978.

2c. E. M. Hansen, L. C. Schreiner and J. F. Miller, Application of Probably Maximum Precipitation Estimates - United States East of the 105th Meridian, Hydrometeorological Report No. 52, National Weather Service and U. S. Army Corps of Engineers, Washington, D. C., August 1982.

3. W. D. Mitchell, Unit Hydrographs in Illinois, Division of Waterways, State of Illinois, 1948.

4. R. M. White, Frequency of Maximum Water Equivalent of March Snow Cover in North Central United States, Technical Paper No. 50, U. S. Weather Bureau, 1964.

5. W. D. Mitchell, Floods in Illinois: Magnitude and Frequency, U. S. Geological Survey, 1954.

6. Smith et al., Grundy County Soils, Soil Report No. 26, University of Illinois Agricultural Experiment Station, Urbana, Illinois, March 1924.

7. Hopkins et al., Kankakee County Soils, Soil Report No. 13, University of Illinois Agricultural Experiment Station, Urbana, Illinois, June 1916.

8. V. T. Chow, Open-Channel Hydraulics, McGraw-Hill Book Company, New York, 1959.

9. B. Barker, Letter to Harza Engineering Company, Division of Water Resource and Management, Illinois Department of Transportation, November 6, 1972.

10. Spillway Rating and Floor Routing, Hydrologic Engineering Center, Computer Program 22-J2-L210, U. S. Army Corps of Engineers, October 1966.

11. U. S. Army Corps of Engineers, Computations of Freeboard Allowances for Waves in Reservoirs, Engineer Technical Letter No. 1110-2-8, August 1, 1966.

12. Saville, McClendon, and Cochran, "Freeboard Allowances for Waves in Inland Reservoirs", Journal of the Waterways and Harbors Division, ASCE, pp. 93-124, May 1962.

These pages have been deleted.

QUESTION 241.3

"Provide information on the strength specified for the lean concrete, mudmat, and bash*used as backfill material beneath and surrounding Category I structures and buried pipes. Furnish plots presenting results of quality control tests performed to verify that the actual construction is in compliance with the specifications."

"'*Lean Concrete'"

RESPONSE

Results of the compressive strength tests performed for the lean concrete used beneath and surrounding Category I structures and buried piping indicate that the actual strength is higher than the design strength.

The average actual ultimate bearing pressure of the lean concrete used for Category I structures exceeds the ultimate bearing capacity of the founding strata.

The essential service water pipeline (ESWP) is the only Category I buried pipe. The average actual ultimate bearing pressure of the lean concrete placed under the ESWP exceeds the ultimate bearing capacity of the founding glacial till. The average actual ultimate bearing pressure of the lean concrete used as a backfill material exceeds the ultimate bearing pressure of the compacted granular fill.

Table Q241.3-1 provides a comparison of the actual strength of the lean concrete and the ultimate bearing pressure of the founding strata applicable to specified structures.

TABLE Q241.3-1

ULTIMATE BEARING PRESSURES OF BACKFILL
FOR CATEGORY I STRUCTURES AND BURIED PIPE

CATEGORY I STRUCTURE OR PIPELINE	AVERAGE ACTUAL ULTIMATE BEARING PRESSURE OF BACKFILL MATERIAL (ksf)	ULTIMATE BEARING PRESSURE OF THE FOUNDING STRATA (ksf)
Containment Building Unit 1	165	150
Containment Building Unit 2	170	150
Auxiliary Building	211	150
Fuel Handling Building	175.6	150
Essential Service Water Pipeline Foundation	75	45
Essential Service Water Pipeline Encasement	75.5	20

QUESTION 251.2

"To demonstrate that Byron Unit 2 and Braidwood Unit 2 comply with the fracture toughness requirements of Paragraph IV.A.1 of Appendix G provide for these units:

a. the material specification, class and grade, the RT_{NDT} and the nil-ductility temperature for each base material in the reactor vessels

b. the heat identification, the RT_{NDT} and the nil-ductility temperature for the reactor vessel weld which is most limiting for operation of the reactor vessels."

RESPONSE

The reactor vessel material property information for Byron Units 1 and 2 and Braidwood Units 1 and 2 is given in Tables Q251.2-1 through Q251.2-4.

TABLE Q251.2-3

BRAIDWOOD UNIT 1 REACTOR VESSEL FRACTURE TOUGHNESS PROPERTIES

COMPONENT	HEAT NUMBER	MATERIAL SPECIFICATION	Cu (%)	P (%)	T_{NDT} (°F)	RT_{NDT} (°F)	UPPER SHELF ENERGY NPWD* (ft-lbs)	UPPER SHELF ENERGY PWD** (ft-lbs)
Closure Head Dome	D1398-1	A533B, Cl. 1	.06	.009	-30	-30	129	-
Closure Head Ring	49C1126-1-1	A508, Cl. 3	.02	.009	-20	-20	123	-
Closure Head Flange	2030-V-1	A508, Cl. 2	.11	.009	-20	-20	163	-
Vessel Flange	122N357VA1	A508, Cl. 2	-	.010	-10	-10	106	-
Inlet Nozzle	21-3257	A508, Cl. 2	.09	.008	-20	-20	144	-
Inlet Nozzle	21-3257	A508, Cl. 2	.09	.010	-10	-10	144	-
Inlet Nozzle	22-3313	A508, Cl. 2	.07	.008	-10	-10	130	-
Inlet Nozzle	22-3313	A508, Cl. 2	.07	.010	0	0	115	-
Outlet Nozzle	22-3025	A508, Cl. 2	.13	.013	-10	-10	125	-
Outlet Nozzle	4-3329	A508, Cl. 2	.08	.009	-20	-20	156	-
Outlet Nozzle	4-3383	A508, Cl. 2	.08	.008	-20	-20	147	-
Outlet Nozzle	11-5226	A508, Cl. 2	.09	.007	-10	-10	125	-
Nozzle Shell	5P-7016	A508, Cl. 2	.04	.008	-10	-10	155	-
Upper Shell	49D383/49C344	A508, Cl. 3	.05	.008	-30	-30	122	173
Lower Shell	49D867/49C813	A508, Cl. 3	.03	.007	-20	-20	135	151
Bottom Head Ring	49D248-1-1	A508, Cl. 3	.05	.008	-50	-50	147	-
Bottom Head Dome	C4882-1	A533B, Cl. 1	.14	.010	-20	-20	123	-
Upper to Lower Shell Girth Weld***	Sub Arc Weld		.04	.015	40	40	80	-

*Normal to Principal Working Direction
**Principal Working Direction
***Limiting Vessel Weld (Weld Control No. WF-562 - Wire Heat No. 442011, Linde 80 Flux Lot No. 8061)

TABLE Q251.2-4

BRAIDWOOD UNIT 2 REACTOR VESSEL FRACTURE TOUGHNESS PROPERTIES

COMPONENT	HEAT NUMBER	MATERIAL SPECIFICATION	Cu (%)	P (%)	T_{NDT} (°F)	RT_{NDT} (°F)	UPPER SHELF ENERGY NPWD* (ft-lbs)	UPPER SHELF ENERGY PWD** (ft-lbs)
Closure Head Dome	B9754-1	A533B, Cl. 1	.16	.005	-60	-60	151	-
Closure Head Ring	50C478-1-1	A508, Cl. 3	.05	.006	-30	-30	128	-
Closure Head Flange	2031-V-1	A508, Cl. 2	-	.009	20	20	135	-
Vessel Flange	124P455	A508, Cl. 2	.07	.010	20	20	128	-
Inlet Nozzle	41-5414	A508, Cl. 2	.07	.008	-10	-10	137	-
Inlet Nozzle	41-5414	A508, Cl. 2	.07	.009	-10	-10	140	-
Inlet Nozzle	42-5417	A508, Cl. 2	.09	.011	-10	-10	122	-
Inlet Nozzle	42-5417	A508, Cl. 2	.09	.009	-10	-10	116	-
Outlet Nozzle	4-3502	A508, Cl. 2	.09	.012	-10	-10	155	-
Outlet Nozzle	11-5226	A508, Cl. 2	.09	.009	-10	-10	116	-
Outlet Nozzle	4-3481	A508, Cl. 2	.07	.008	-10	-10	163	-
Outlet Nozzle	11-5266	A508, Cl. 2	.09	.010	10	10	117	-
Nozzle Shell	5P-7056	A508, Cl. 2	.04	.005	30	30	115	-
Upper Shell	49D963/49C904	A508, Cl. 3	.03	.007	-30	-30	119	147
Lower Shell	50D102/50C97	A508, Cl. 3	.06	.006	-30	-30	144	168
Bottom Head Ring	49D1066-1-1	A508, Cl. 3	.07	.008	-30	-30	156	-
Bottom Head Dome	D1429-1	A533B, Cl. 1	.11	.010	-20	-20	120	-
Upper to Lower Shell Girth Weld ***	Sub Arc Weld		.04	.015	40	40	80	-

*Normal to Principal Working Direction
**Principal Working Direction
***Limiting Vessel Weld (Weld Control No. WF-562 - Wire Heat No. 442011, Linde 80 Flux Lot No. 8061)

RPM COMMITMENTS
TIMOTHY D. KEITH
STATION HEALTH PHYSICIST - BRAIDWOOD STATION

Assignment: Six weeks at Zion Station during the current refueling outage.

Duties: Supervise professionals and bargaining group technicians in performing their Health Physics duties concerning surveys, decontamination, dosimetry, sampling, respiratory protection and instrumentation. Additional experience is to be gained in containment entry, steam generator work, and Inservice Inspection.

Assignment: Byron Station during Start-Up.

Duties: To be involved in important details of PWR Start-Up. Specific experience is to be gained in performing original surveys and surveys through power escalation.

Assignment: Byron Station during first refueling.

Duties: To be involved in important Health Physics details of first refueling. Specific experience is to be gained in power deescalation, vessel opening, and fuel movements. This training is predicated upon the fact that Braidwood Station would not be concurrently involved in its own startup. If it is not possible for this experience to be gained directly, a meeting will be held involving Byron and Braidwood Health Physics personnel to discuss both the positive and negative Health Physics aspects of the first Byron Station refueling outage.

Assignment: Six days Introduction to Power Plant Operations.

Duties: Specific training was gained in system theory and control board operation through the use of the Byron/Braidwood simulator (completed May 1983).

Assignment: Three days Management By Objectives.

Duties: Specific training is to be gained in job planning and in achieving goals.

Assignment: Three days Kepner-Tregoe.

Duties: Specific training is to be gained in decision making.

Appraisal: Following the completion of Braidwood Station's first refueling outage, the Corporate Health Physics Staff will conduct an appraisal of Braidwood Station's Health Physics Program. A report will be sent to the Nuclear Division V.P. and General Manager, Station Superintendent, Rad/Chem Supervisor and the Radiation Protection Manager.

Dated 9/13/83

7720N

Table Q362.1-1 is a summary of the maximum measured differential settlements for all construction and operational monuments. Table Q362.1-2 is a summary of projected maximum total and differential settlements for each Category I structure. These total and differential settlements have been calculated after reviewing the stabilized elevations. The stabilized elevations have been identified on the settlement plots. Some allowance has been made in the total settlement due to the small amount of building load that still remains to be placed. The new operational phase monuments, installed in September 1981, clearly show that their maximum differential settlement is less than or equal to -0.01 feet (-0.011 feet maximum). This settlement is considered negligible and indicates that settlement has stabilized.

The differential settlements given in Table Q362.1-2 are all less than or equal to -0.03 feet. This is significantly less than 1/2-inch or more which was assumed in the design of the auxiliary building and fuel handling building. The only safety-related pipe or conduit that is not suspended is the essential service water pipeline. This pipeline travels beneath the heater bay building and enters the turbine room mat. Beneath the heater bay, it is encased in reinforced concrete and supported on till or rock. The point of maximum differential settlement occurs as the encased pipeline enters the turbine room mat. The pipeline is designed to take with adequate margin the 1/2-inch estimated differential settlement in this area.

It is concluded that all Category I structures have been designed to account for the maximum total and differential settlement.

The lake screen house is founded within a very stiff to hard glacial till of the Wedron Formation. The till is overconsolidated and has an ultimate bearing capacity of approximately 45,000 psf (Subsection 2.5.4.10.1.2). The approximate static bearing pressure for the screen house is 3,000 psf resulting in a factor of safety of 15. The estimated settlement of the screen house is less than 1/4 inch total and 1/8 to 1/4 inch differential (Subsection 2.5.4.10.2.2). Construction phase settlement monitoring was not performed for the lake screen house but will be included in the operational phase settlement monitoring.

TABLE Q362.1-1

TABULATED DIFFERENTIAL SETTLEMENTS FOR SURVEY MONUMENTS

BUILDING	MONUMENT NUMBER	PERIOD OF MEASUREMENT	MAXIMUM MEASURED DIFFERENTIAL MOVEMENT (Feet)	DIFFERENTIAL MOVEMENT BASED ON STABILIZED ELEVATION (FT)
Fuel	9	2/79 to 12/81	+0.002	
	10	2/79 to 8/80	-0.012	-0.015
	New 10	9/81 to 10/82	0.000	
	New 9	9/81 to 10/82	-0.002	
	51	9/81 to 10/82	+0.002	
	52	9/81 to 10/82	0.000	
Refueling Water Storage Tanks	40	2/79 to 8/80	-0.025	-0.010
	New 40	9/81 to 10/82	+0.003	
	55	9/81 to 10/82	0.000	
Auxiliary Building	KK	2/77 to 8/80	-0.059	-0.039
	LL	2/77 to 8/77	-0.013	
	JJ	2/77 to 5/77	-0.010	
	21	2/79 to 8/80	-0.020	-0.010
	22	2/79 to 8/80	-0.013	-0.010
	23	2/79 to 8/80	-0.015	-0.005
	24	2/79 to 8/80	-0.020	-0.015
	26	2/79 to 8/80	-0.021	-0.020
	27	2/79 to 8/80	-0.027	-0.020
	28	2/79 to 8/80	-0.025	
	New 21	9/81 to 10/82	+0.006	
	New 26	9/81 to 10/82	+0.013	
	New 27	9/81 to 10/82	0.000	
	New 29	9/81 to 10/82	+0.001	
	53	9/81 to 10/82	-0.002	
	54	9/81 to 10/82	-0.001	
Unit 1 Containment	U	2/77 to 8/80	-0.061	-0.070
	V	2/77 to 8/80	-0.052	-0.063
	N	2/77 to 8/80	-0.080	-0.067
	N_2	3/77 to 6/77	-0.014	
	N_4	3/77 to 6/77	-0.014	
	P	2/77 to 8/77	-0.004	
	13	2/79 to 2/80	-0.012	-0.008
	14	2/79 to 8/80	-0.005	-0.007
	15	2/79 to 8/80	-0.010	-0.012
	36	2/79 to 8/80	-0.003	-0.012
	39	2/79 to 8/80	-0.018	-0.012
	New U	9/81 to 10/82	-0.002	
	New V	9/81 to 10/82	+0.018	
	New N	9/81 to 10/82	-0.001	
	New 3	9/81 to 10/82	-0.001	
	New 37	9/81 to 10/82	-0.004	
	New 39	9/81 to 10/82	+0.002	

TABLE Q362.1-1 (Cont'd)

BUILDING	MONUMENT NUMBER	PERIOD OF MEASUREMENT	MAXIMUM MEASURED DIFFERENTIAL MOVEMENT (Feet)	DIFFERENTIAL MOVEMENT BASED ON STABILIZED ELEVATION(FT)
Unit 1 Safety Valve Room	1 (Northeast Room)	2/79 to 8/80	-0.011	-0.015
	3 (Northwest Room)	2/79 to 8/80	-0.027	-0.025
Unit 2 Safety Valve Room	42	2/79 to 8/80	-0.024	-0.015
Unit 2 Containment	AA	2/77 to 6/77	+0.005	
	BB	2/77 to 6/77	+0.006	
	R	2/77 to 8/77	-0.001	
	R_1	2/77 to 8/77	-0.014	
	R_2	2/77 to 5/77	-0.020	
	R_3	2/77 to 8/77	-0.013	
	R_4	2/77 to 8/80	-0.078	-0.074
	Z	2/77 to 8/80	-0.064	-0.065
	18	2/79 to 8/80	-0.020	-0.015
	19	2/79 to 8/80	-0.024	-0.018
	20	2/79 to 8/80	-0.020	-0.012
	43	2/79 to 8/80	-0.017	-0.008
	44	2/79 to 5/80	-0.007	-0.010
	Z1	9/81 to 10/82	-0.001	
	New R4	9/81 to 10/82	-0.006	
	New 17	9/81 to 10/82	-0.009	
	New 18	9/81 to 10/82	-0.004	
	New 41	9/81 to 10/82	-0.011	
	New Z	9/81 to 10/82	+0.002	
Units 1&2 Turbine Room	CC	2/77 to 5/77	-0.001	
	HH	2/77 to 8/77	-0.033	
	T	2/77 to 8/77	-0.002	
	W	3/77 to 8/77	-0.013	
	X	2/77 to 8/77	+0.001	
	4	2/79 to 8/80	-0.010	-0.015
	5	2/79 to 8/80	-0.001	-0.005
	6	2/79 to 8/82	+0.003	0
	33	2/79 to 8/82	-0.005	0
	New 4	9/81 to 10/82	-0.006	
	New 33	9/81 to 10/82	-0.005	
	New 34	9/81 to 10/82	0.000	
	56	9/81 to 10/82	-0.010	
	58	9/81 to 10/82	-0.004	
	59	9/81 to 10/82	-0.007	
Heater Bay	57	9/81 to 10/82	-0.009	
Radwaste/Service Building	DD	2/77 to 8/77	-0.003	
	XX	2/77 to 8/80	-0.013	-0.023
	34	2/79 to 8/80	-0.008	0

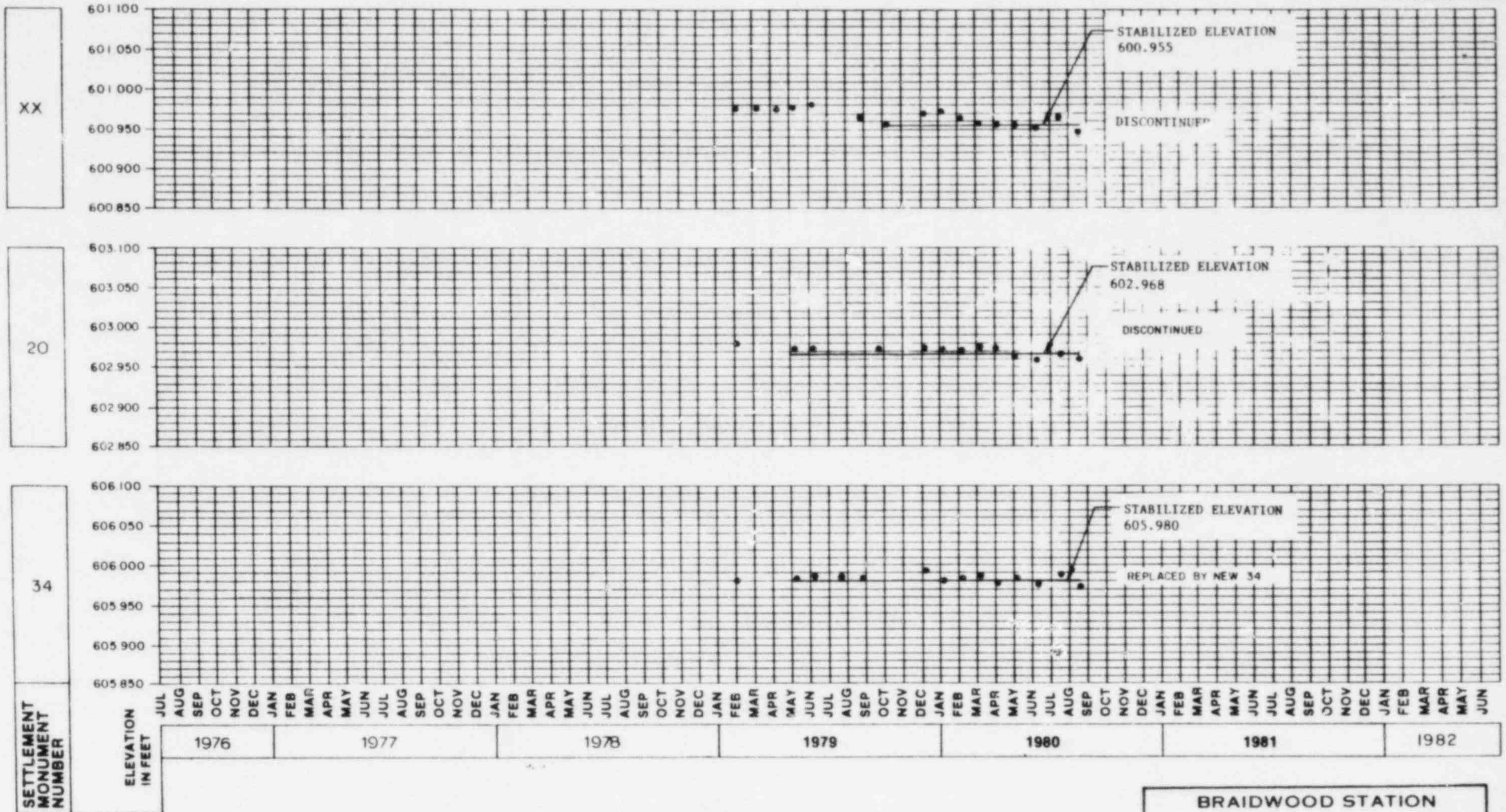
TABLE Q362.1-2

PROJECTED MAXIMUM TOTAL AND DIFFERENTIAL SETTLEMENTS

CATEGORY I STRUCTURE	PROJECTED MAXIMUM* TOTAL SETTLEMELNT (Feet)	MAXIMUM DIFFERENTIAL SETTLEMENT (Feet)
Unit 1 Containment	-0.074	-0.01
Unit 2 Containment	-0.078	-0.01
Auxiliary Building	-0.041	-0.03
Fuel Building	-0.04**	-0.02**
Refueling Water Tanks	-0.04**	-0.02**

* Projected maximum total settlement determined by increasing by 5% the difference between stabilized monument elevations and the monument initial elevations. Monuments U, V, Z, N, R_4, and KK were monitored from the beginning of construction to August 1980. These monuments were used to compute total settlement for the containments and auxiliary building areas.

**Settlement values given here are estimated conservatively because a significant amount of construction occurred before monuments were installed. Actual measurements indicate less than or equal to -0.025 feet total settlement.

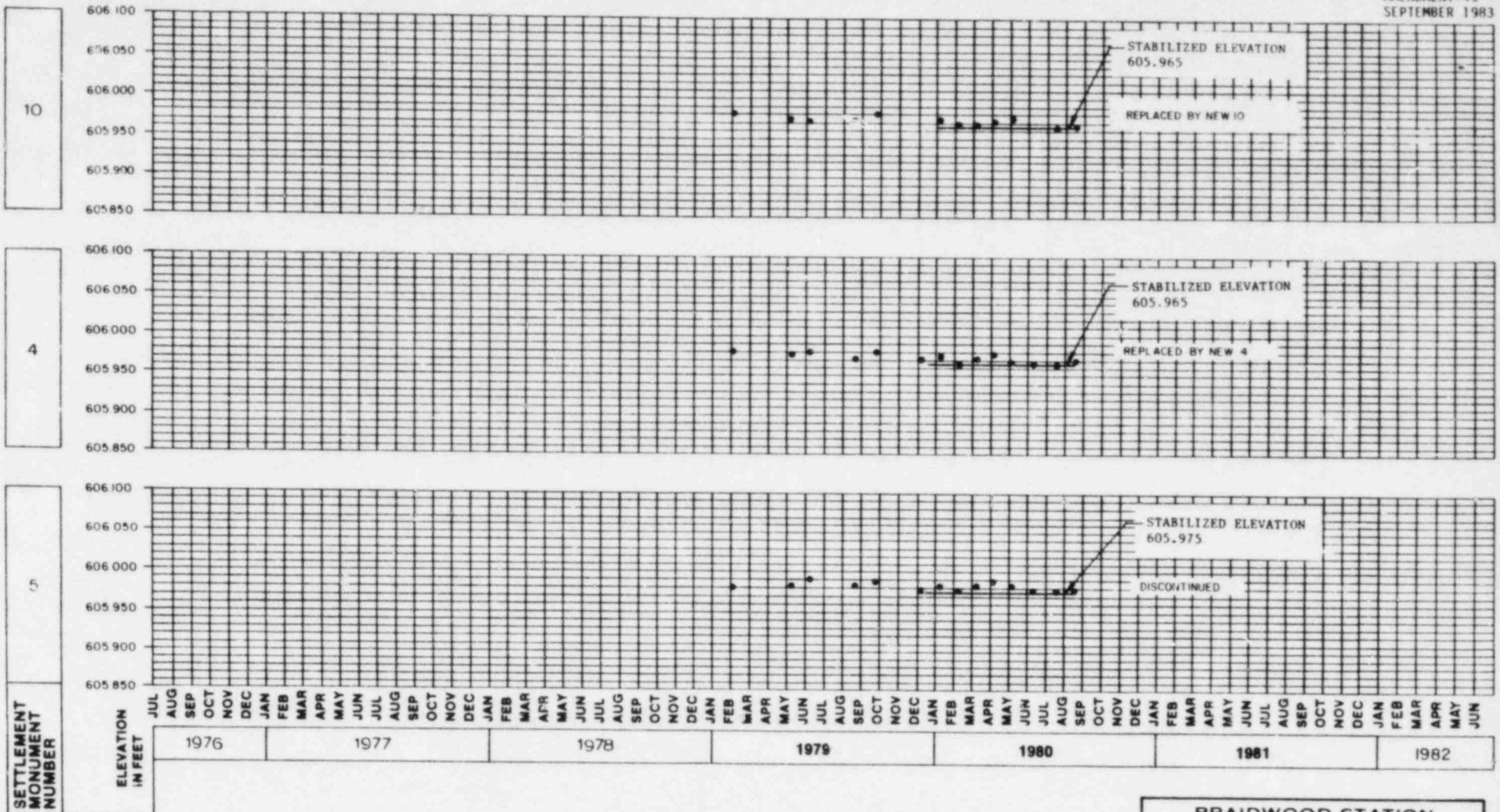


BRAIDWOOD STATION
FINAL SAFETY ANALYSIS REPORT

FIGURE Q362.1-10

SETTLEMENT PLOTS FOR
MONUMENTS XX, 20, 34

Q362.1-15



BRAIDWOOD STATION

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FIGURE Q362.1-11

SETTLEMENT PLOTS FOR MONUMENTS 10, 4, 5

Q362.1-16

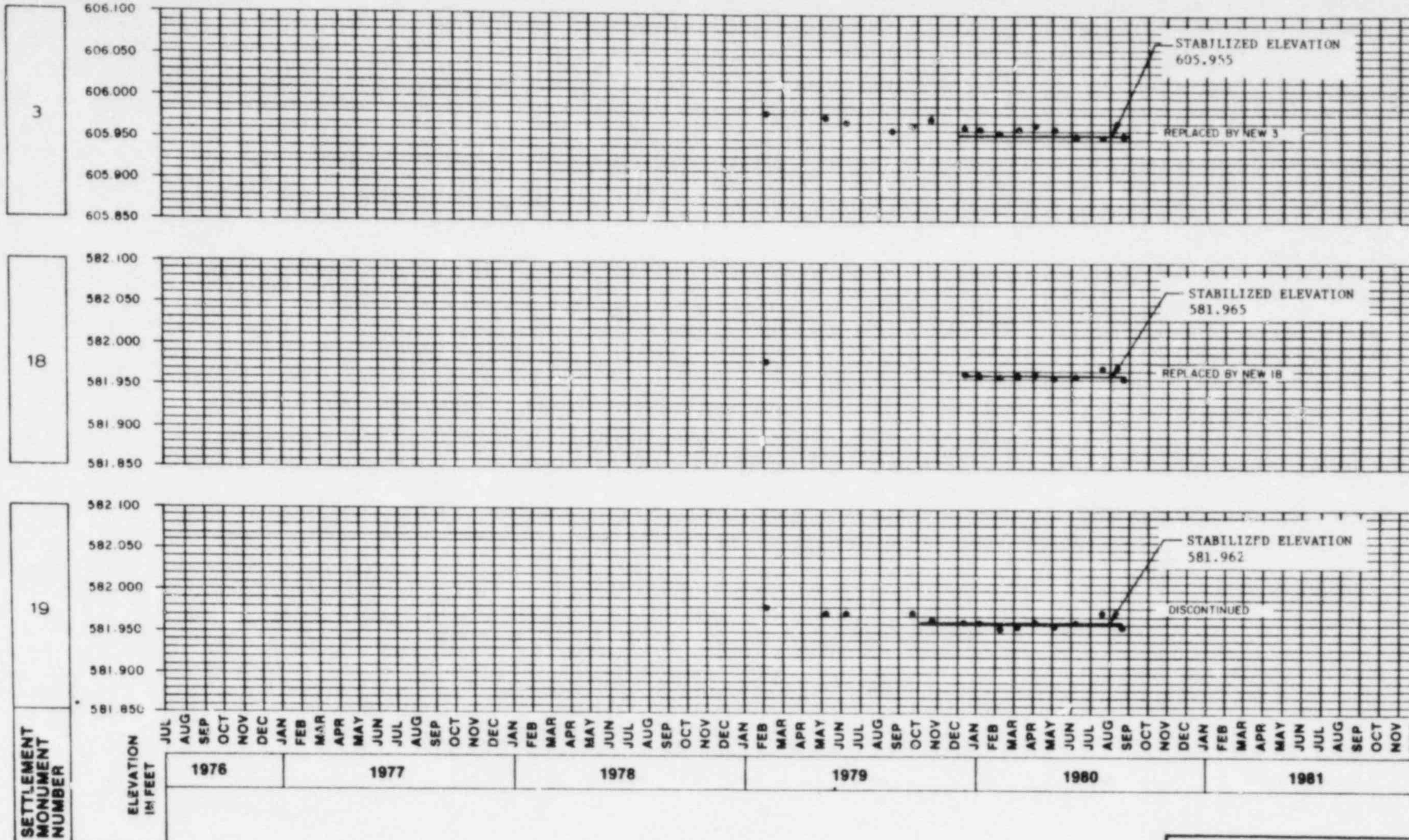

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FIGURE Q362.1-12

SETTLEMENT PLOTS FOR
MONUMENTS 3, 18, 19

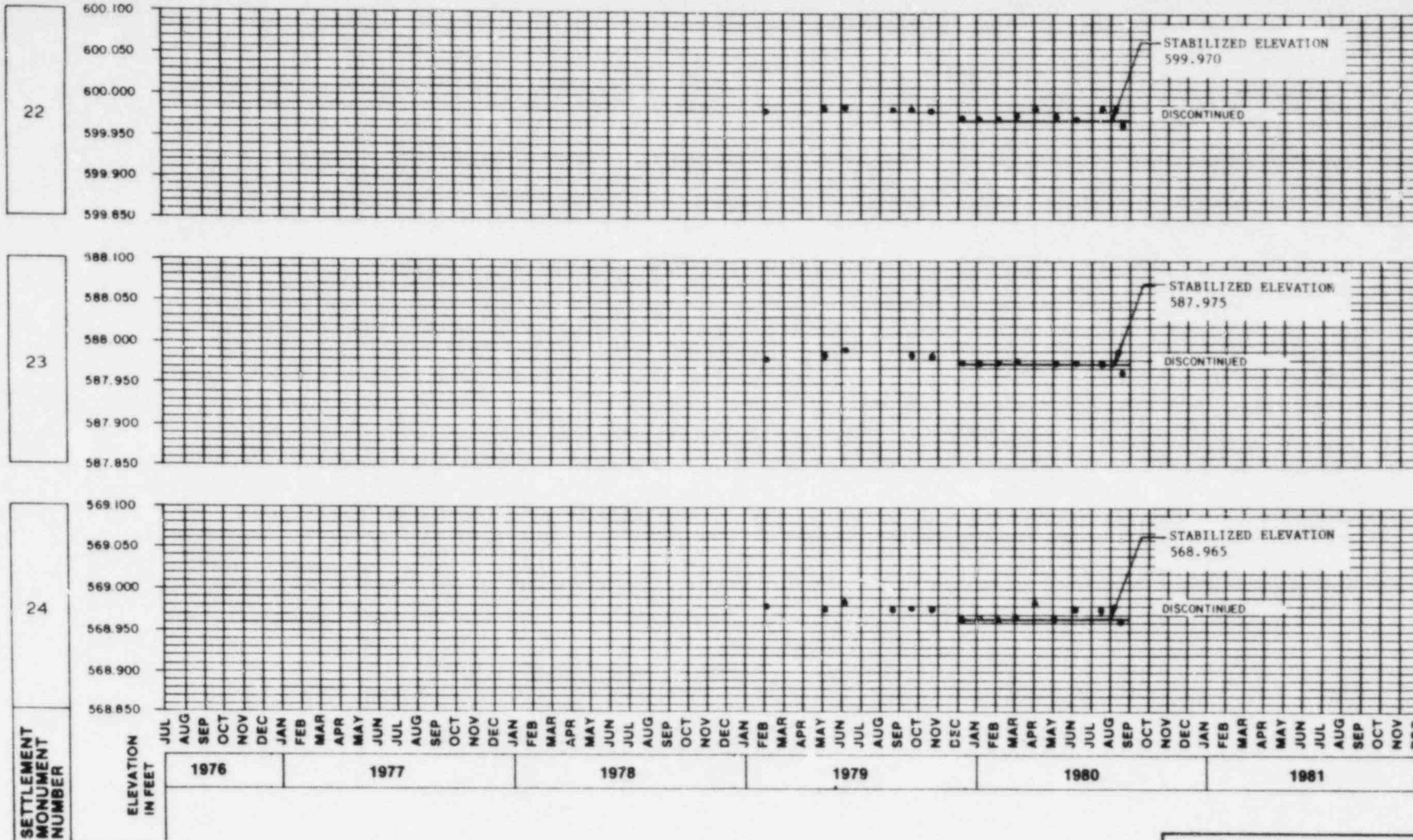

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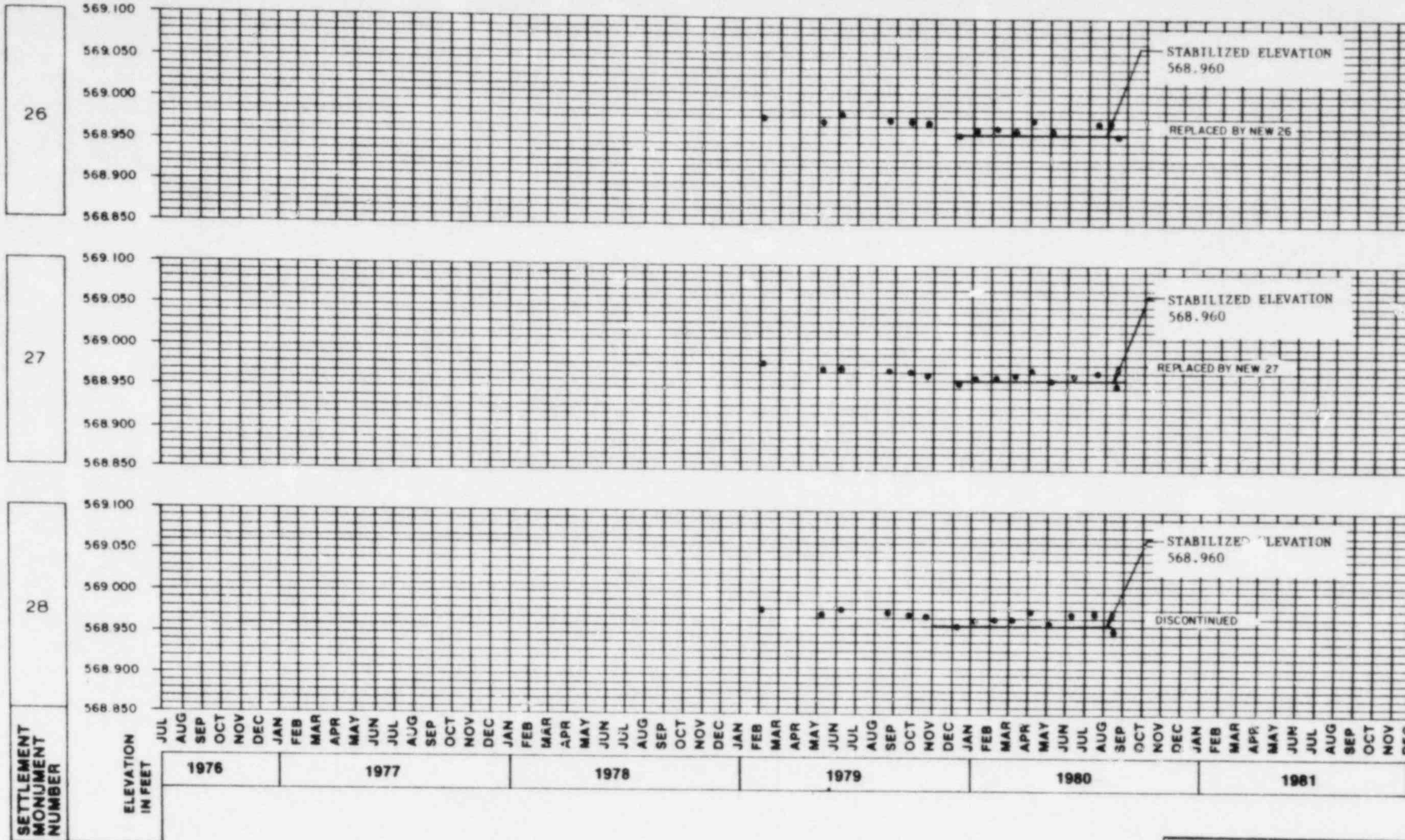
FIGURE Q362.1-14

SETTLEMENT PLOTS FOR MONUMENTS 22, 23, 24

Q362.1-19



BRAIDWOOD STATION

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FIGURE Q362.1-15

SETTLEMENT PLOTS FOR MONUMENTS 26, 27, 28

Q362.1-20

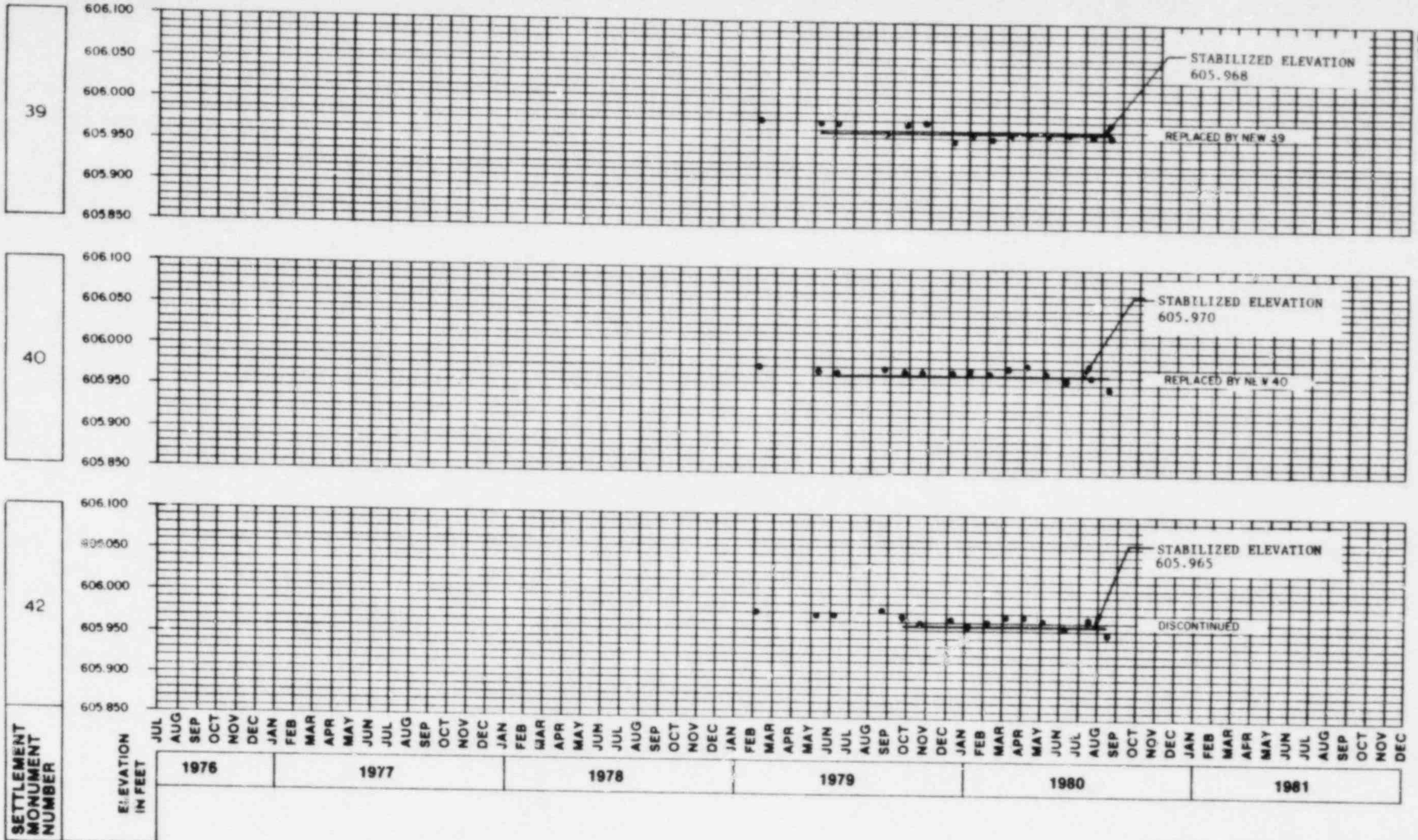

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FIGURE Q362.1-16

SETTLEMENT PLOTS FOR MONUMENTS 39, 40, 42

Q362.1-21

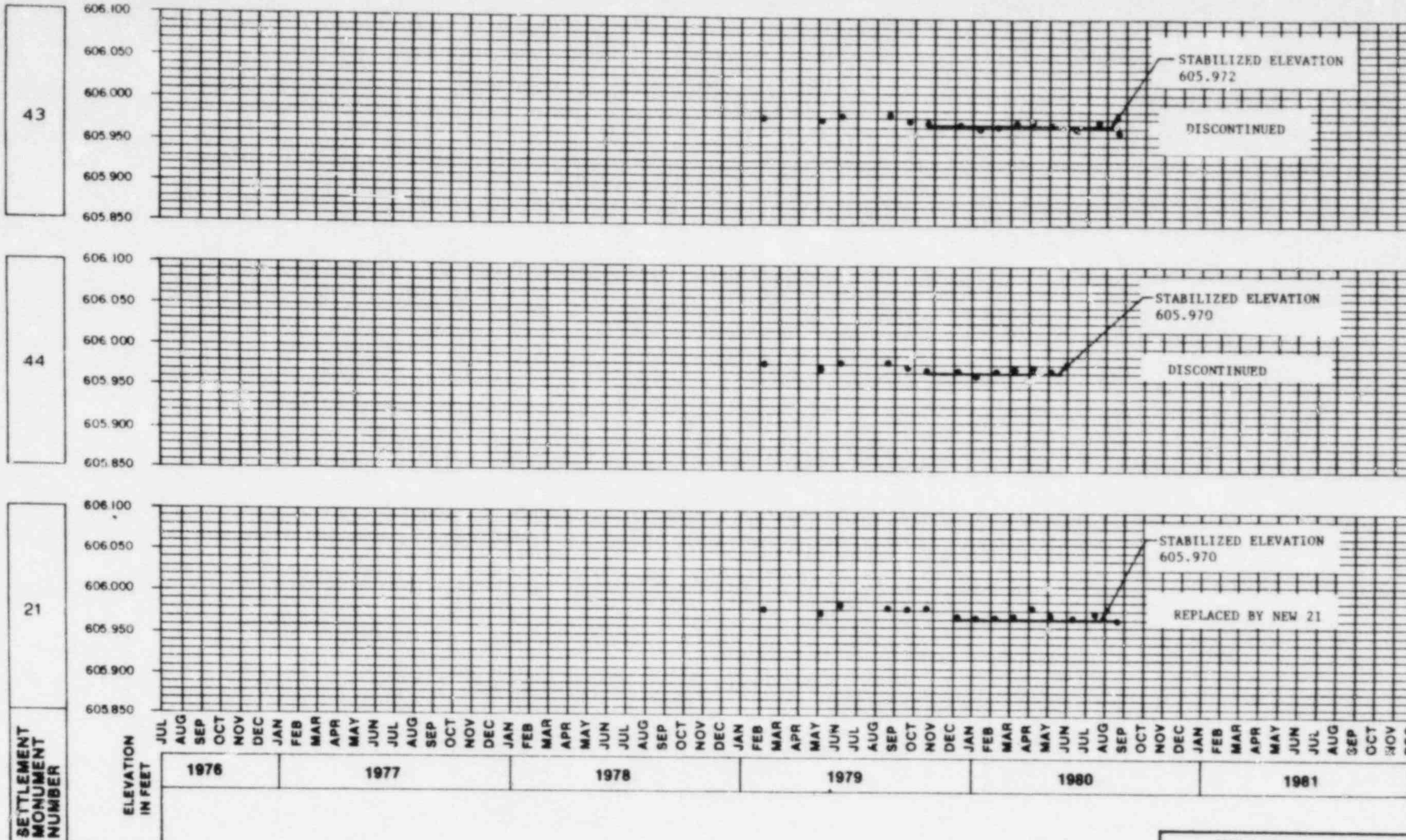

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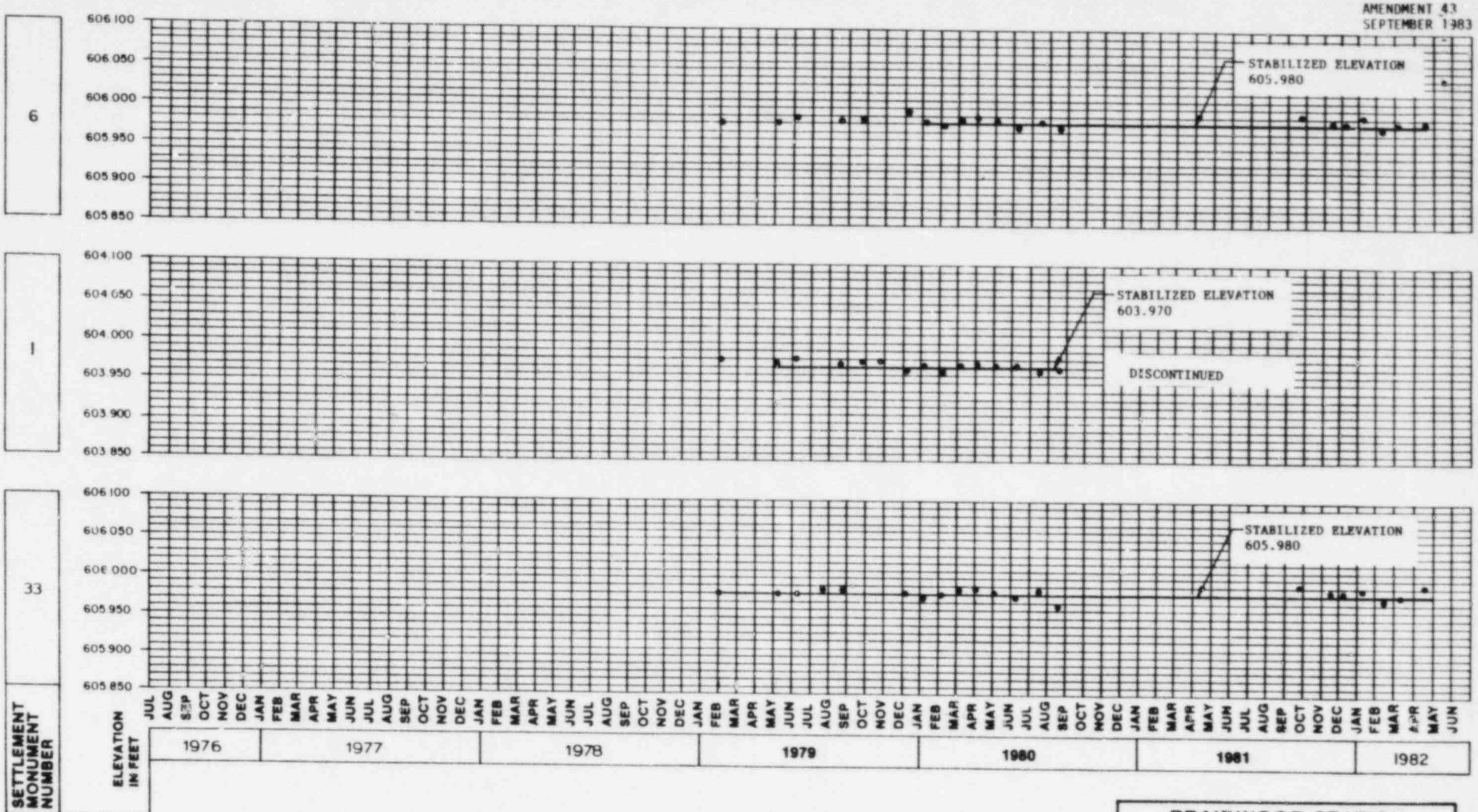
FIGURE Q362.1-17

SETTLEMENT PLOTS FOR MONUMENTS 43, 44, 21

Q362.1-22



BRAIDWOOD STATION

FINAL SAFETY ANALYSIS REPORT

FIGURE Q362.1-18

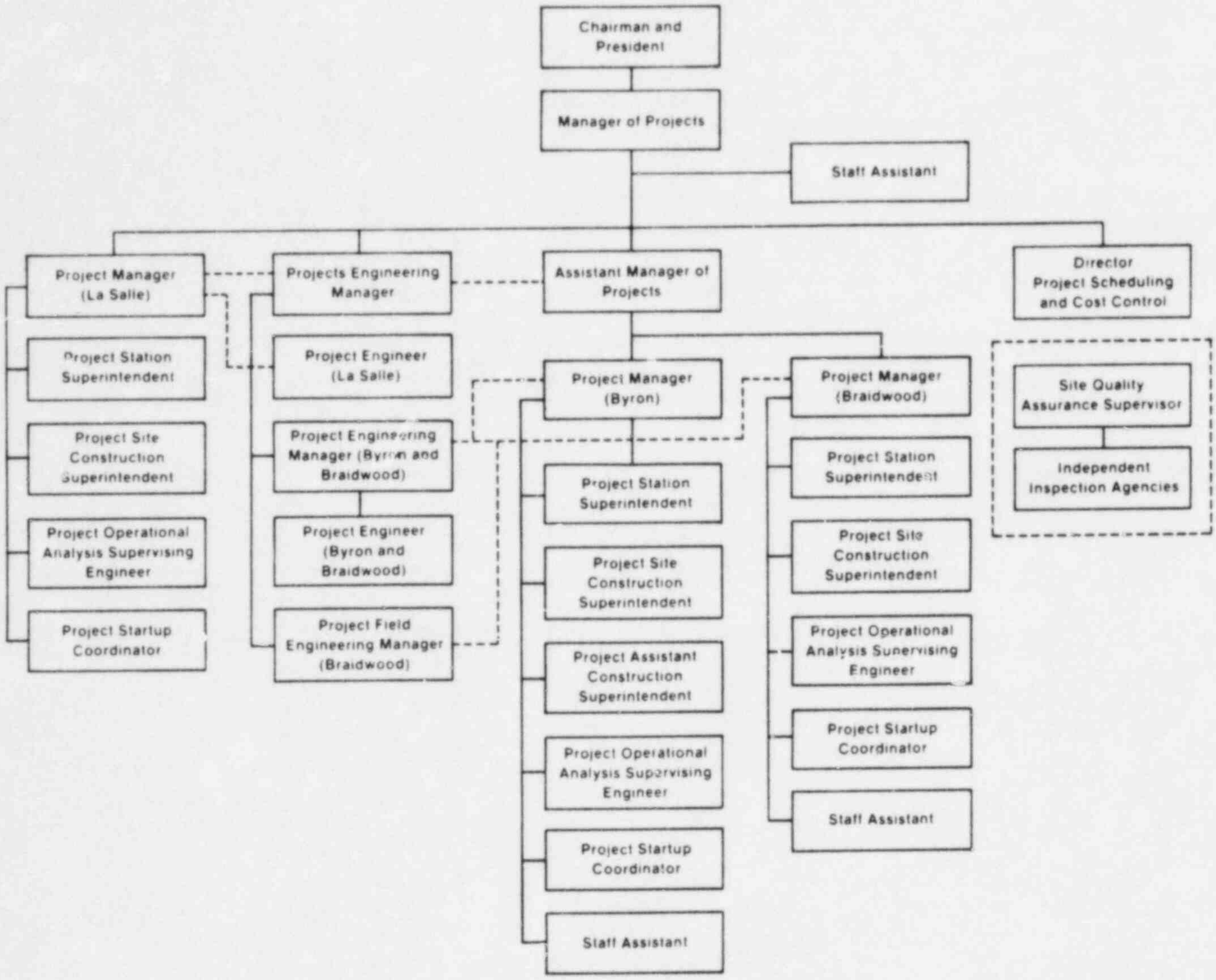
SETTLEMENT PLOTS FOR MONUMENTS 6, 1, 33

(SHEET 1 OF 2)

Q362.1-23

CHAPTER 13.0 - CONDUCT OF OPERATIONS

LIST OF FIGURES

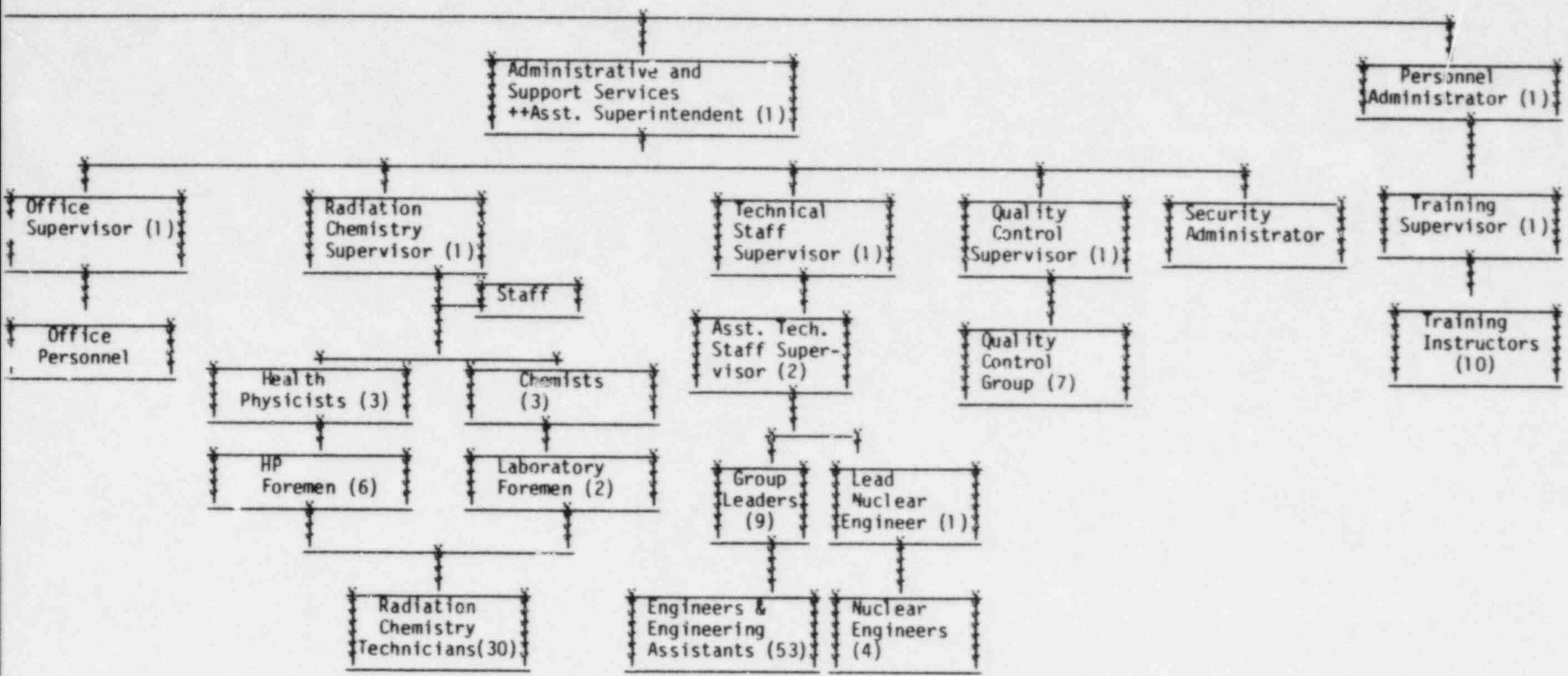


BYRON/BRAIDWOOD STATIONS

FINAL SAFETY ANALYSIS REPORT

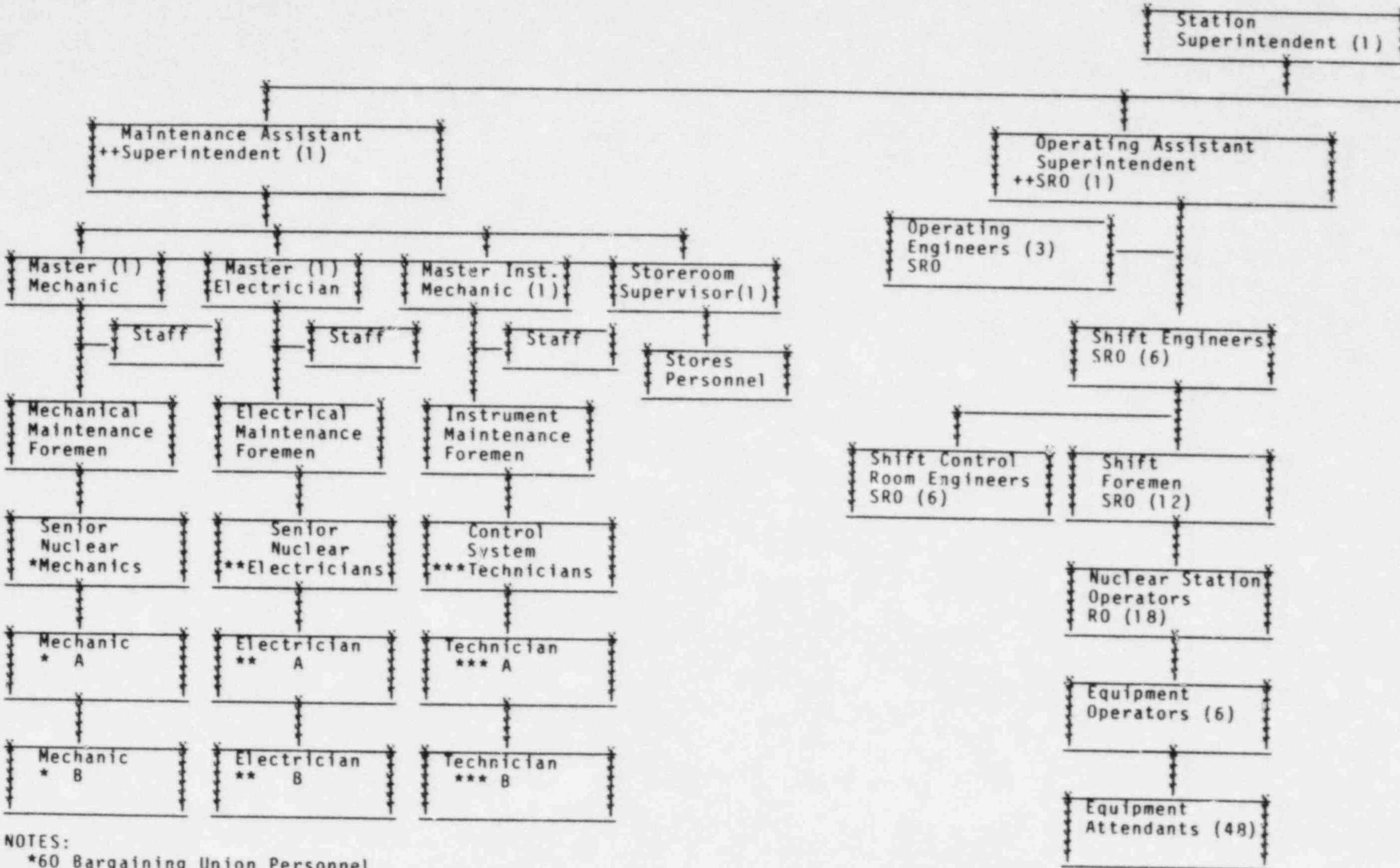
FIGURE 13.1-1

PROJECT MANAGEMENT ORGANIZATION



BRAIDWOOD PLANT STAFF

Figure 13.1



NOTES:
*60 Bargaining Union Personnel
**20 Bargaining Union Personnel
***30 Bargaining Union Personnel
++One of these will hold a valid SRO license.

0058m
0052A