Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

May 15, 2003
NOC-AE-03001532
File No.: G25
10CFR50.55a

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498, STN 50-499
Request for One-Time Approval of an Alternative Approach for
Containment Tendon Surveillances (RR-ENG-2-34)

Reference: Letter, T. J. Jordan to NRC Document Control Desk, "Response to Request for Additional Information Regarding Revised Request for Approval of an Alternative Approach for Containment Tendon Surveillances (RR-ENG-37), dated January 6, 2003 (NOC-AE-02001439)

In accordance with the provisions of 10CFR50.55a(a)(3)(ii), the South Texas Project requests approval of an alternative to ASME Section XI, sections IWL-2421 and IWL-2500, which specify the surveillance requirements for containment concrete and unbonded post-tensioning systems. The proposed alternative surveillance is a one-time relief request, good for the 15th year surveillance only. Implementation of all required elements of the 15th year surveillance would result in hardship, without a compensating increase in the level of quality and safety.

The South Texas Project requests Nuclear Regulatory Commission approval of this proposed alternative surveillance by July 2, 2003, to allow scheduling and performance of the 15th year surveillance during 2003. Although this request is neither exigent nor an emergency, prompt review by the Nuclear Regulatory Commission is requested.

If there are any questions, please contact either Mr. R. L. Engen at (361) 972-7363, or me at (361) 972-7902.

TJJordan

T. J. Jordan
Vice President,
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MWW / PLW

Attachment: Request for One-Time Approval of an Alternative Approach for Containment Tendon Surveillances (RR-ENG-2-34)

A047

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ATTACHMENT

REQUEST FOR ONE-TIME APPROVAL OF AN ALTERNATIVE APPROACH FOR CONTAINMENT TENDON SURVEILLANCES (RR-ENG-2-34)

SOUTH TEXAS PROJECT
UNITS 1 AND 2
Request for One-Time Approval of an Alternative Approach for Containment Tendon Surveillances (RR-ENG-2-34)

A. Components for Which Exemption is Requested

Component: Reactor Containment Concrete and Unbonded Post-Tensioning Systems

Function: To provide containment structural integrity while maintaining a leak-tight barrier to radiological release in the event of a loss of coolant or steam line break accident.

Class: ASME Code Class CC

B. Applicable Code

ASME Boiler & Pressure Vessel Code, Section XI, 1992 Edition

C. Code Requirements from Which Relief is Requested

IWL-2421 (b)

The South Texas Project (STP) falls under the jurisdiction of IWL-2421 (b), which specifies the surveillance schedule for containment structures having the following attributes:

- A two-unit plant;
- Both Containment structures use the same pre-stressing system and are essentially identical in design;
- Post-tensioning operations were completed less than two years apart; and
- Both Containment structures are similarly exposed to the outside environment.

The surveillances required at STP during the 15th year are:

(1) For the containment with the first Structural Integrity Test (Unit 1), only the examinations required by IWL-2524 and IWL-2525 need be performed.

(2) For the containment with the second Structural Integrity Test (Unit 2), all examinations required by IWL-2500 shall be performed.

STP requests relief from the requirement to perform IWL-2524 and IWL-2525 in Unit 1, proposing instead to perform no surveillance in Unit 1 at the 15th year. STP further requests relief from the requirement to perform *all* examinations required by IWL-2500 in Unit 2. The specific provisions of IWL-2500 from which relief is sought in Unit 2 are delineated below.

IWL-2510

IWL-2510 requires visual examination of all accessible concrete exterior surfaces. STP requests relief to permit examination of only the surfaces that can be safely and conveniently inspected without use of a crane.

<u>IWL-2521</u>

IWL-2521 specifies random selection of tendons for surveillance. STP will comply with these requirements for vertical tendons, but requests relief to permit non-random selection of the most easily accessible horizontal tendons.

<u>IWL-2523</u>

IWL-2523 requires tendon detensioning and wire removal for testing for one horizontal and one vertical tendon. STP requests relief from all portions of IWL-2523.

D. Basis for Relief from Code Requirements

Based on the inspection results from previous cycles and the conservatism inherent in the STP design, there is little value to be gained by conducting a full inspection this year. Given the expected rate of change in the material condition of the containment structure, the specified inspections result in the hardship of unnecessary expense and risk to workers, without commensurate benefit to public safety.

E. Proposed Alternate Examination

The South Texas Project requests approval to apply a revised 15th year containment inspection as an alternative to that specified in ASME Section XI, Subsections IWL-2421 (b), IWL-2510, IWL-2521, and IWL-2523. The revised inspection will have the following attributes:

- Perform no surveillance in Unit 1
- In Unit 2, perform IWL-2522 (liftoff testing), IWL-2524 (examination of anchorage areas), IWL-2525 (examination of grease), and IWL-2526 (documentation of grease removal and replacement) on three vertical tendons randomly chosen in accordance with IWL-2521, and three horizontal tendons specifically chosen for ease of accessibility. Perform IWL-2510 (concrete surface examination) only to the extent it can be safely and conveniently done without use of a crane.

F. Basis for Alternative

<u>Containment Layout</u>

The South Texas Project containment structure is a post-tensioned concrete cylinder with internal steel liner plates, hemispherical top and flat bottom. The cylinder and the dome are pre-stressed by a post-tensioning system consisting of horizontal and vertical ("inverted U") tendons. The purpose of the containment post-tensioning system is to provide strength to resist internal pressure during postulated design basis accidents.

Three buttresses equally spaced around the Containment provide anchor points for the horizontal tendons. The cylinder and the lower half of the dome are pre-stressed by horizontal tendons that completely encircle the structure, such that both ends of the tendon are anchored at the same buttress, bypassing the intermediate buttresses. Anchorage for each successive hoop is progressively offset 120 degrees from the one beneath it.

The vertical inverted U-shaped tendons are continuous over the dome, forming a two-way post-tensioning system for the dome. These tendons are anchored in a continuous gallery beneath the base slab, thereby providing access for inspection.

Each tendon has 186 high-strength wires ¼-inch in diameter. The minimum ultimate tensile strength in the wires is 240 ksi. The minimum initial prestress was 70% of the minimum ultimate tensile strength. Each unit has 133 horizontal and 96 vertical tendons.

Containment Structural Design

The containment building is designed to resist an internal pressure of 56.5 psig, which is substantially greater than the calculated maximum accident pressure (40.5 psig). This provides a substantial inherent margin. Furthermore, the tendons are sized to have a predicted average end-of-life prestress at least 20% greater than the force required to equilibrate an internal pressure of 56.5 psig, while taking no credit for rebar. This design concept represents significant conservatism beyond ASME requirements. It implies no tensile stress in the concrete, rebar or liner, even when subjected to internal pressure greater than the STP design pressure. This is conservative because ASME allows significant tensile strain in the liner. Considering tendons alone, and allowing liner strains up to the ASME allowable limit, the containment pressure capacity would be 71 psig, not 56.5 psig. Even higher pressure would be allowed if rebar were considered.

The rebar at STP is sized to resist non-pressure loads, i.e. seismic, tornado, thermal, shrinkage, piping and live loads (polar crane). The predicted end-of-life prestress forces were added to the containment finite element analysis as external applied loads. Since the prestress forces closely equilibrate the factored internal pressure, any load combination involving both prestress and pressure has a very small net effect from prestress and pressure. For this reason, any credible loss of prestress has a relatively small impact on load cases other than internal pressure. Therefore, only the effect on pressure capacity will be discussed hereafter.

Consequences of Tendon Degradation

No consequences are expected from the reduced surveillance. However, it is possible that a degraded condition will go undetected for a longer time as a result of reduced surveillance.

For discussion purposes, it is useful to break tendon degradation into two broad categories: 1) loss of prestress; and 2) loss of strength (i.e. through physical loss of material due to corrosion).

Loss of Prestress: The principal consequence of loss of prestress is larger strains. If strains in the liner become large enough, leak-tightness can be lost. As indicated above, the STP design provides enough prestress to maintain net compression in the concrete and liner. Therefore, liner strain is well below the ASME tensile limit. A relatively large prestress loss could be permitted. During the first 10 years of plant life, measured losses have been consistent with predictions. The prestress loss rate after year 10 could increase to a rate 10 times greater than predicted without consuming the available design margin.

Loss of Strength: Taking no credit for rebar, the containment pressure capacity is 71 psig, assuming there is adequate prestress to keep the liner strain within the allowable limit. This means that in order to maintain a code allowable capacity of at least the LOCA pressure (40.5 psig) only 57% of each tendon is needed (i.e. 40.5 / 71 = 0.57 = 57%). In other words, 43% of the cross sectional area of each tendon could be removed and the STP containment would still be strong enough to withstand the maximum calculated accident pressure, assuming only that the remaining portions of the tendons maintained an appropriate prestress.

Margin of Safety

The South Texas Project containment structure includes a substantial design margin for pressure. The design pressure for the building is 56.5 psig, but the calculated maximum pressure that could occur following a design basis accident is 40.5 psig. The resulting design margin is 40% [56.5/40.5 = 1.40]. This exceeds the minimum design margin of 10% specified for plants in the construction stage of review as stated in Section 6.2.1.1.A of the Standard Review Plan (NUREG-0800, 1981). No margin is specified in the Standard Review Plan for the operating license stage of review. STP has substantial additional conservatism due to the manner in which the prestress forces were established, as discussed in previous paragraphs.

Previous Examination Results

Examinations have been conducted at one, three, five, and ten years following the initial post-tensioning operations for Unit 1 and Unit 2.

The containment concrete surface, including coated areas, has been visually examined for areas of large spalling, severe scaling, cracking, other surface deterioration or disintegration, or significant grease leakage. No damage or degradation of the concrete surfaces was identified during the examinations.

The condition of unbonded post-tensioning systems has been determined by:

- Tendon force measurements;

  Test results are summarized in Table 1.

- Tendon wire and strand sample examination and testing;

  At each surveillance that included liftoff testing, one wire was removed from each of two tendons (one horizontal and one vertical) along with the anchorage hardware and inspected for deterioration or corrosion. All tendon wires and anchorage hardware were free of corrosion with no signs of cracking.

- Examination of tendon anchorage areas;

  The anchor components were inspected (after end-cap removal) for corrosion protection medium coverage. All were properly covered.

  The concrete surface surrounding the bearing plates was visually inspected for evidence of cracks greater than 0.01-inch in width. The only cracks identified were minor surface shrinkage cracks, a normal characteristic of concrete.

- Examination of corrosion protection medium and free water;

  Samples of the corrosion protection medium were tested for water content, reserve alkalinity, concentrations of water-soluble chlorides, nitrates, and sulfides. The values were well below the acceptable limits specified in Table IWL-2525-1.

- Addition of corrosion protection medium.

Grease additions have been evaluated and found acceptable. No evidence of internal grease leakage has been found.

Information Notice 99-10

Information Notice 99-10 discusses three tendon-related NRC concerns: 1) wire breakage; 2) accelerated relaxation; and 3) lack of proper trending.

Breakage: The STP design assumes 1% wire breakage. With 186 wires per tendon, and 229 tendons total, this implies 426 broken wires per unit. To date, STP has documented less than 30 broken or damaged wires in each unit (0.07%) with about half of these being the result of destructive surveillance testing and all but one of the others occurring during initial installation. The one exception was a failed buttonhead that was identified as deficient at installation. There has been no in-service wire breakage.

Accelerated Relaxation: Laboratory test data used to estimate tendon tension relaxation was obtained at approximately 70 degrees Fahrenheit. However, because actual tendon temperature may be higher than that, there is potential for underestimating steel relaxation. IEN 99-10 states that as much as 20% of prestress could be lost due to relaxation. The STP design assumes relaxation losses of only 9.7%. Hence, there is a potential for unanticipated prestress loss of 10.3% of initial prestress. As discussed elsewhere in this attachment, such losses would be of no consequence.

Trending: The trends were calculated using regression analysis of individual liftoff results, as suggested by IEN 99-10. Results from previous tendon examinations show that the projected trends of tendon pre-stress loss are close to the predicted behavior. The IWL-3221.1 (b) limit for acceptability is 95% of the predicted value, meaning that the measured prestress is acceptable if it is no more than 5% less than the predicted prestress. The trend lines for the four tendon groups indicate that pre-stress loss will remain in the acceptable range for the life of the plant. The trend data are summarized in Table 2 and Figures 1 through 4.

Details of the regression analysis were provided previously in the referenced letter. The analysis was done in terms of percent deviation from predicted values. The results have been reformatted as Figures 1 through 4. As an illustration of the correlation between Table 2 and the figures, Table 2 shows that the Unit 1 horizontals are trending toward 3.5% below predicted. Figure 1 shows a predicted value of 1265 kips for this same group at year 40, with a trend value of 1221 kips. [1265 x (1 – 0.035) = 1221].

The figures show that the trends are 5 – 20% above the design requirement. This represents margin in addition to the substantial margin inherent in the design requirement. (As discussed previously, the "design requirement" is prestress 20% greater than the force required to equilibrate 56.5 psig internal pressure.) The liftoff forces measured during past surveillances at years 1, 5 and 10 are plotted in the figures as data ranges rather than individual points. All individual measured forces were previously provided to the NRC in tabular form in the referenced letter.

Hardship Status

The estimated total cost of performing the required 15th year surveillances is $800,000. Performance of the full surveillance provides no discernable benefit to the public and no measurable increase in quality or safety beyond what is provided by the proposed alternative surveillance. Therefore, the required surveillance is a significant cost without a compensating increase in the level of quality and safety.

Summary

Over the ten-year history of surveillance at the South Texas Project, the post-tensioning system has behaved as designed. No damage or degradation of the tendons or concrete surfaces has been observed. All tendon groups are following prestress loss trends that are projected to remain acceptable for 40 years of plant life. Most importantly, the design includes a substantial margin, such that pre-stress loss would have to be far greater than predicted to reduce the ability of the containment structure to withstand the calculated accident pressure loads. Any degradation this large should be detectable with the proposed alternative surveillance. Therefore, the proposed 15th year surveillance is appropriate. The required 15th year surveillance imposes a hardship on STP with no compensating increase in the level of quality and safety.

G. Duration of Proposed Alternative

This relief request modifies the surveillance program for the 15th year surveillance only.

H. Implementation Schedule

The South Texas Project requests Nuclear Regulatory Commission approval by July 2, 2003, to support scheduling and performing the 15th year surveillance in 2003.

Table 1

Tendon Force Measurement Summary:

Deviation from Predicted Values (%)

	Unit 1 Horizontal	Unit 1 Vertical	Unit 2 Horizontal	Unit 2 Vertical
Low	-5.9	-1.7	-5.9	-1.0
Median	1.1	0.7	0.3	2.3
Mean	0.7	0.9	1.3	2.5

Table 2

Tendon Force Projected Trends:

Projected Deviation from Predicted Values (%)

Trend	Unit 1 Horizontal	Unit 1 Vertical	Unit 2 Horizontal	Unit 2 Vertical
Yr. 15	-1.91	1.71	-0.75	5.32
Yr. 20	-2.38	1.87	-1.08	5.75
Yr. 30	-3.03	2.09	-1.55	6.35
Yr. 40	**-3.50**	2.25	-1.88	6.78

FIGURE 1 - AVERAGE LIFTOFF FORCE TREND: Unit 1 Horizontals

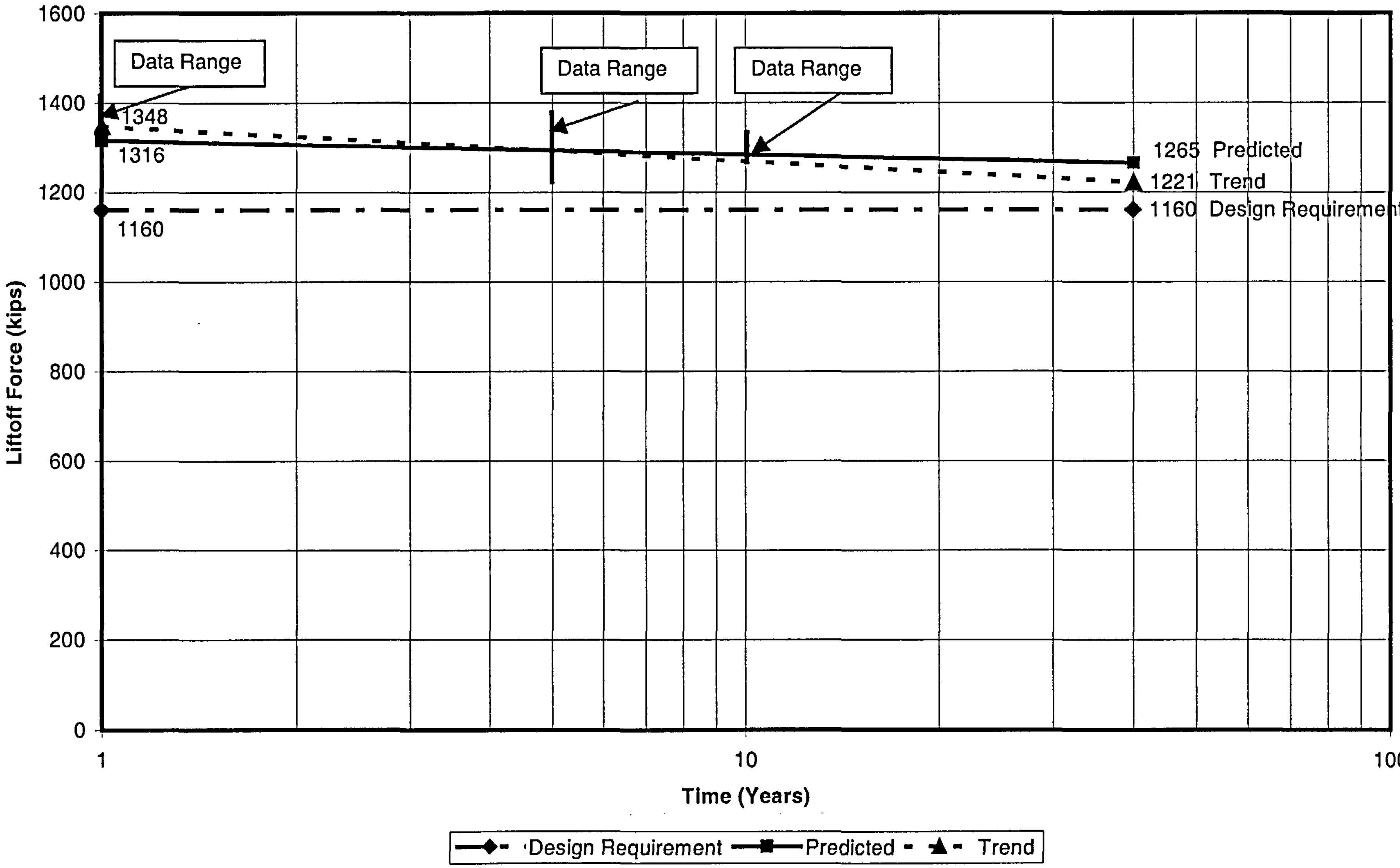

FIGURE 2 - AVERAGE LIFTOFF FORCE TREND: Unit 2 Horizontals

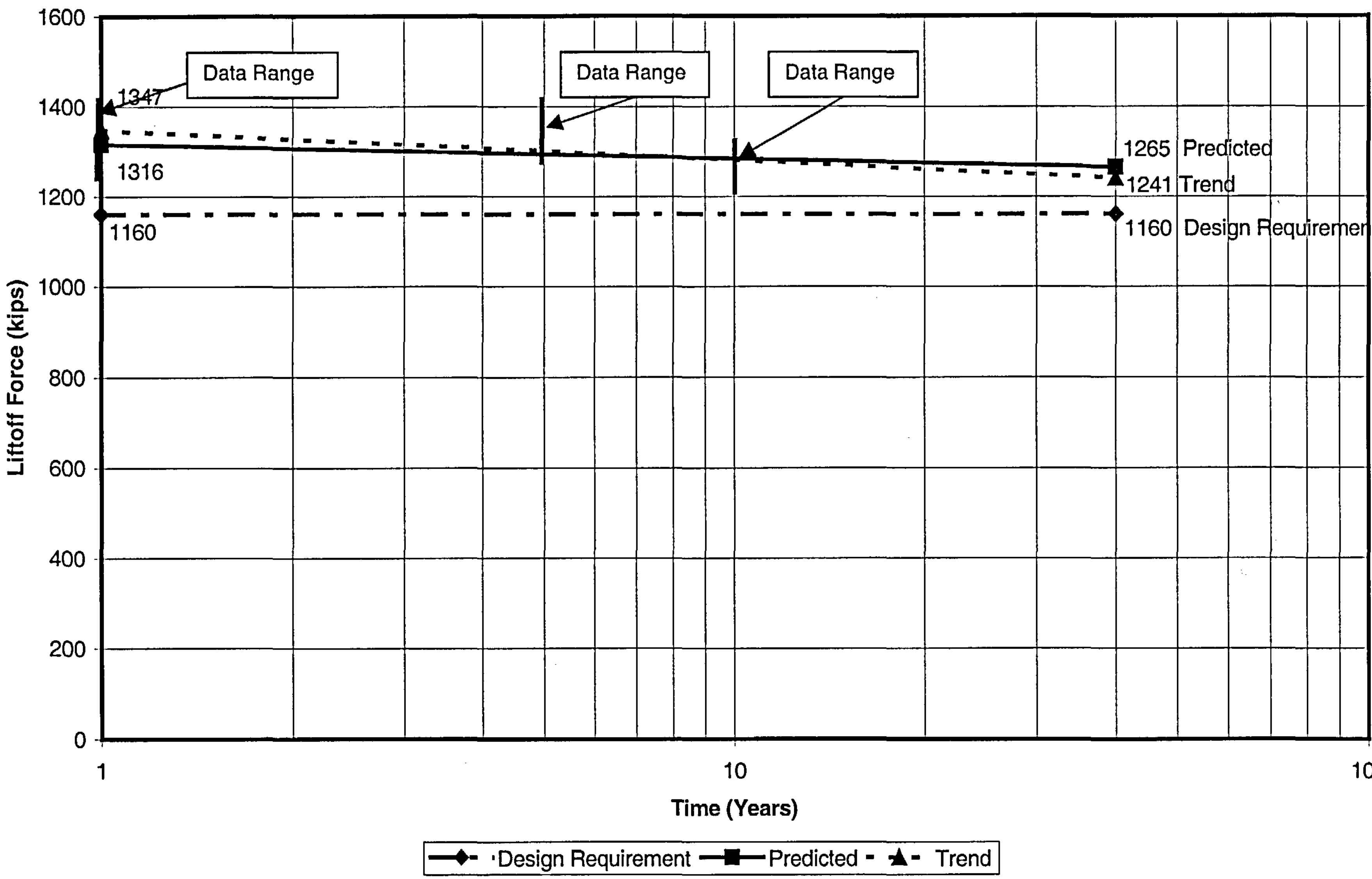

FIGURE 3 - AVERAGE LIFTOFF FORCE TREND: Unit 1 Verticals

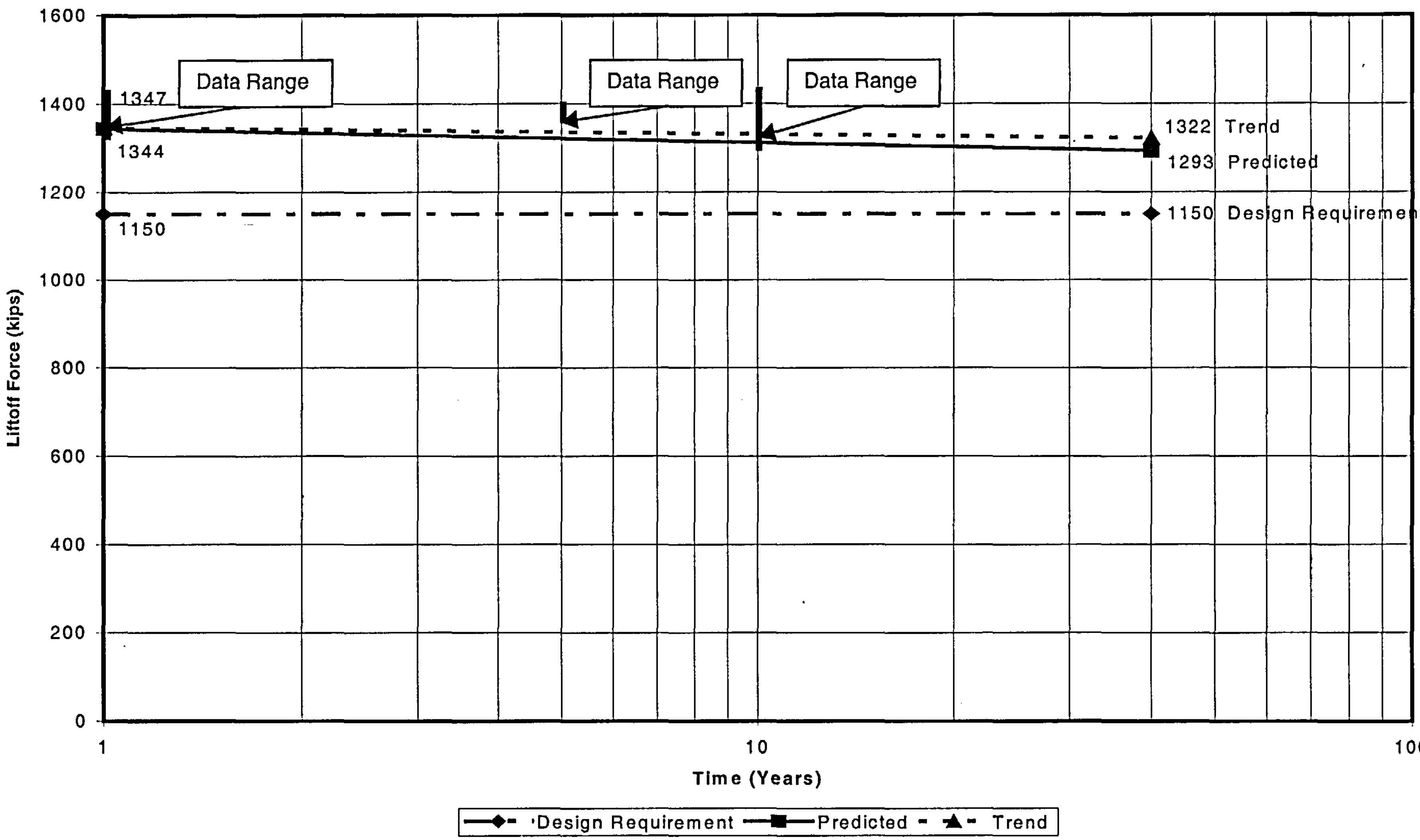

FIGURE 4 - AVERAGE LIFTOFF FORCE TREND: Unit 2 Verticals