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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
KNIGHTON,G. Licensing Branch 3

SUBJECT: Forwards info requested in SSER 5 (NUREG-0857) re tests performed for C-E on load limiting devices in reactor vessel lower key horizontal supports.

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Arizona Public Service Company
P.O. BOX 21666 • PHOENIX, ARIZONA 85036

February 10, 1984
ANPP-28836 - WFQ/MSN

Director of Nuclear Reactor Regulation
Attention: Mr. George Knighton, Chief
Licensing Branch No. 3
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN-50-528/529/530
File: 84-056-026; G.1.01.10; D.4.02.1

Reference: (A) NUREG-0857, Supplement No. 5, November, 1983.
Safety Evaluation Report.
(B) Combustion Engineering (C-E) letter, LD-81-069,
to D.G. Eisenhut from A.E. Scherer, dated October 8, 1981.
Subject: CESSAR-F Round 1 Question Responses.
(C) C-E letter, LD-83-105, to D.G. Eisenhut from A.E. Scherer,
dated December 20, 1983.
Subject: CESSAR-F Load Limiter Tests.
(D) Arizona Public Service (APS) letter, ANPP-28492-WFQ/KEJ,
to G.W. Knighton from E.E. Van Brunt, Jr.,
dated December 23, 1983.
Subject: Schedule for completion of OL Review of PVNGS
Unit 1.

Dear Mr. Knighton:

Attached is the information requested in Reference (A) regarding tests performed for Combustion Engineering (CE) on the load limiting devices in the reactor vessel lower key horizontal supports.

A telephone discussion was held December 21, 1983 between E.A. Licitra (NRC) and M.S. Nelson (APS) to clarify this request as follows:

(i) Submit figure 3.9.1-6b [as stated in Reference (B)]: "Reactor Vessel Lower Key Load Limiter Requirements".

(ii) Submit a description of what testing was done and what the test results mean.

This information is provided in the Attachments to this letter.

A001
1/1

References (C) and (D) had provided updated schedules (first quarter of 1984 and February 29, 1984, respectively) for this submittal.

If you have any questions please contact me.

Very truly yours,

E. E. Van Brunt, Jr.
APS Vice President, Nuclear
ANPP Project Director

EEVB/MSN:pt
Attachments

cc: E. A. Licitra (w/a)
A. C. Gehr (w/a)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

February 10, 1984
ANPP-28836 - WFQ/MSN

I, Edwin E. Van Brunt, Jr., represent that I am Vice President, Nuclear, of Arizona Public Service Company, that the foregoing document has been signed by me on behalf of Arizona Public Service Company with full authority to do so, that I have read such document and know its contents, and that to the best of my knowledge and belief, the statements made therein are true.

Edwin E. Van Brunt

Edwin E. Van Brunt, Jr.

Sworn to before me this 10th day of February, 1984.

Nora E. Meador
Notary Public

My Commission Expires:

My Commission Expires April 6, 1987

ATTACHMENT 1: Revision to FSAR Section 3.9.1.4.1
SEISMIC CATEGORY I NSSS ITEMS

MECHANICAL SYSTEMS AND COMPONENTS

3.9.1.4 Consideration for the Evaluation of the Faulted Condition

3.9.1.4.1 Seismic Category I NSSS Items

Analysis of the reactor coolant system components (reactor vessel, steam generator, reactor coolant pump, pressurizer, and reactor coolant piping) and their supports have been performed in accordance with the methods described in CESSAR Section 3.9.1.4.1. For each component and support member, the calculated loads, in combination with the seismic loads, are below the loads specified for design and the stresses (pipe rupture in combination with SSE) are below those listed in CESSAR Table 3.9.3-2.

No components or supports of the reactor coolant system main loop for PVNGS were designed using the inelastic methods defined in Section III of the ASME Code as plastic instability or limit analysis methods.

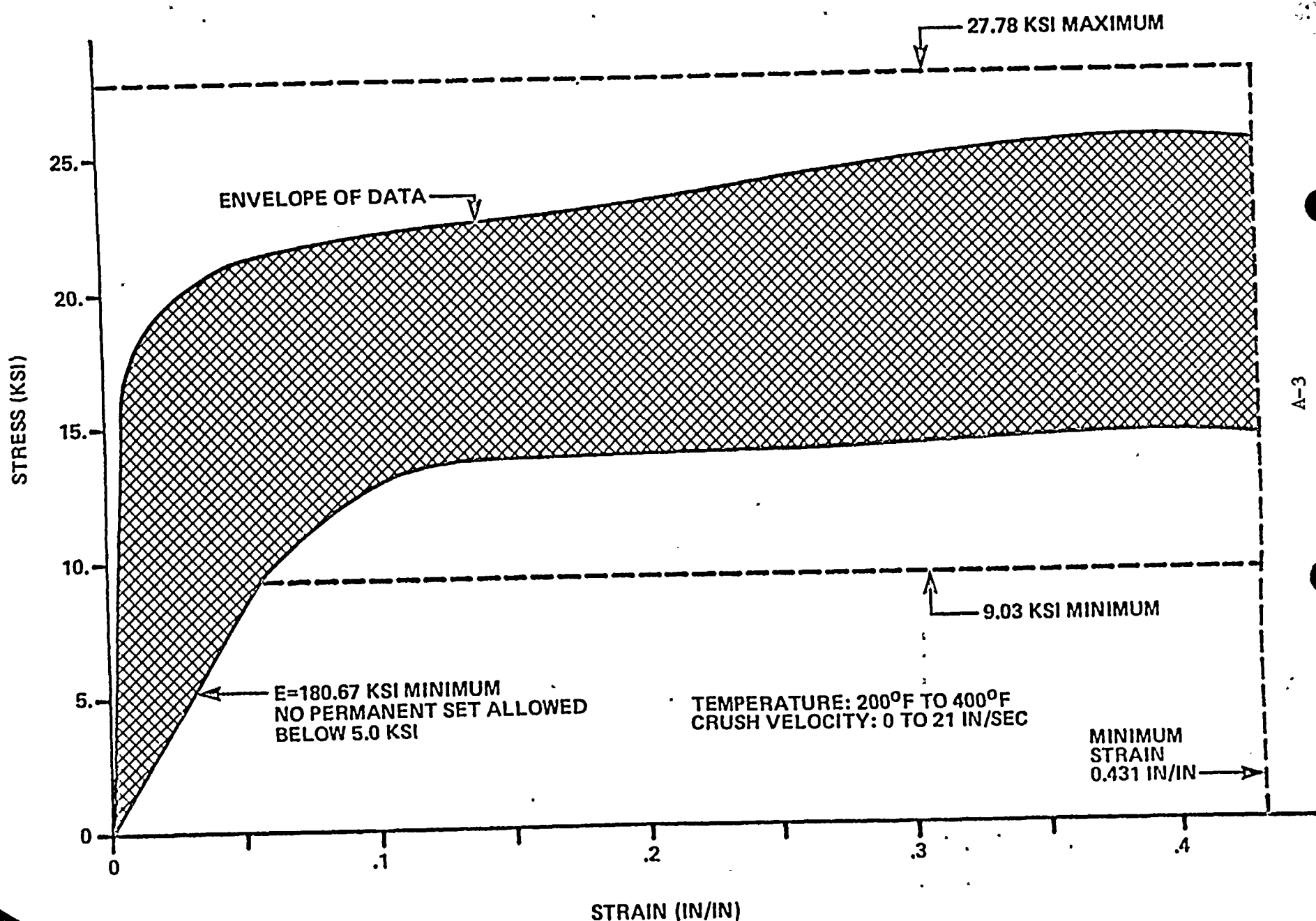
The reactor vessel lower key horizontal supports include load limiting devices in accordance with 5.4.14.2(e) of CESSAR-F. These load limiters are designed to remain elastic for all normal, upset and the SSE loadings, and elastic system analysis is used to establish or confirm the loads specified for design of the components and supports for these conditions. For loads resulting from postulated pipe breaks, the load limiter devices are designed to deflect plastically, and nonlinear system analysis is used accordingly for proper calculation of the distribution of the loads among the system of supports.

Figure 3.9-1 (see page A-3) illustrates the performance requirements specified for the reactor vessel lower support key load limiters. The dashed lines represent the stiffness and load ranges evaluated in the overall system analysis. The test data points were within the envelope indicated by the solid lines. The testing was performed on samples extracted from the heat specific material used in construction.

Twenty-one tests were run at various temperatures and at crush velocities representative of performance requirements. The test results were within the specified load deflection limits.

ATTACHMENT 2: Draft FSAR Figure 3.9-1
REACTOR VESSEL LOWER KEY LOAD LIMITER REQUIREMENTS AND TEST RESULTS

REACTOR VESSEL LOWER KEY LOAD LIMITER REQUIREMENTS AND TEST RESULTS



ATTACHMENT 3
HONEYCOMB TEST DESCRIPTION

A test program was performed to verify that the honeycomb material meets C-E's design requirements. The design requirements are shown on Figure 1 and are summarized as follows:

1. The honeycomb will maintain a minimum stiffness of 8×10^3 kips/inch up to 180 kips without a permanent set.
2. The honeycomb will crush within a load band of 325 kips to 1000 kips.
3. The honeycomb will have a minimum deflection of 0.350 inches.
4. The above three requirements apply over a temperature range of 200°F to 400°F and a crush velocity range from 0 to 21 inches/second.

The test program evaluated the effects of specimen size, specimen temperature and crush velocity on the load-deflection characteristics of the material. Twenty-one tests were performed and consisted of seven basic tests each performed three times. Each stainless steel honeycomb specimen was taken from the same core block number (482-260) of honeycomb material as the production honeycomb for Arizona Nuclear Power Plant Palo Verde Units 1, 2 and 3. All test specimens were precrushed identical to production pieces with the height of the specimens also the same as production pieces. Specimens were connected to a backup plate to be consistent with production hardware. The test program is defined in matrix form in Figure 2.

The laboratory tests were performed by National Technical Systems (NTS), Structural Dynamics Laboratory. The honeycomb samples were tested on the NTS Hiload Dynamic Test Frame. The Test Frame is an electronically servo controlled hydraulic system. The hydraulic actuator and load cell were each fitted with 6" x 10" x 1" steel plattens with integral cartridge heaters. A temperature controller kept the plattens within $\pm$ 5°F of the specific test temperature. The servo command signal was generated by a Hewlett-Packard 5451B Fourier Analyzer, which also acquired the load and deflection data.

Samples were preconditioned in a temperature controlled oven for a minimum of 60 minutes prior to test. The oven was held within $\pm$ 5°F of the specified temperature. Ambient temperature was in the range of 70° to 90°F. As samples were removed from the oven for testing they were placed immediately between the preheated plattens with a 5000 to 8000 pound preload. Typical time from oven to plattens was 10-15 seconds, with the compression cycle following within 20 seconds.

Data was recalled from the HP 5451B disc drive and scaled. Velocity was computed from the first derivative of the displacement time history. Spectral components above a given cutoff frequency were cleared to minimize the high frequency noise inherent in the system. The cutoff frequency for the static tests was 0.6 Hz; the cutoff frequency for all other tests was 150 Hz.

Test results are presented in C-E's FSAR change package for Reactor Vessel Lower Key Load Limiter Requirements. The test results verify that the honeycomb material meets C-E's design load deflection requirements.

HONEYCOMB DESIGN LOAD REQUIREMENTS

Temperature: 200°F to 400°F

Crush Velocity: 0 to 21 inches/sec. in the principle load direction

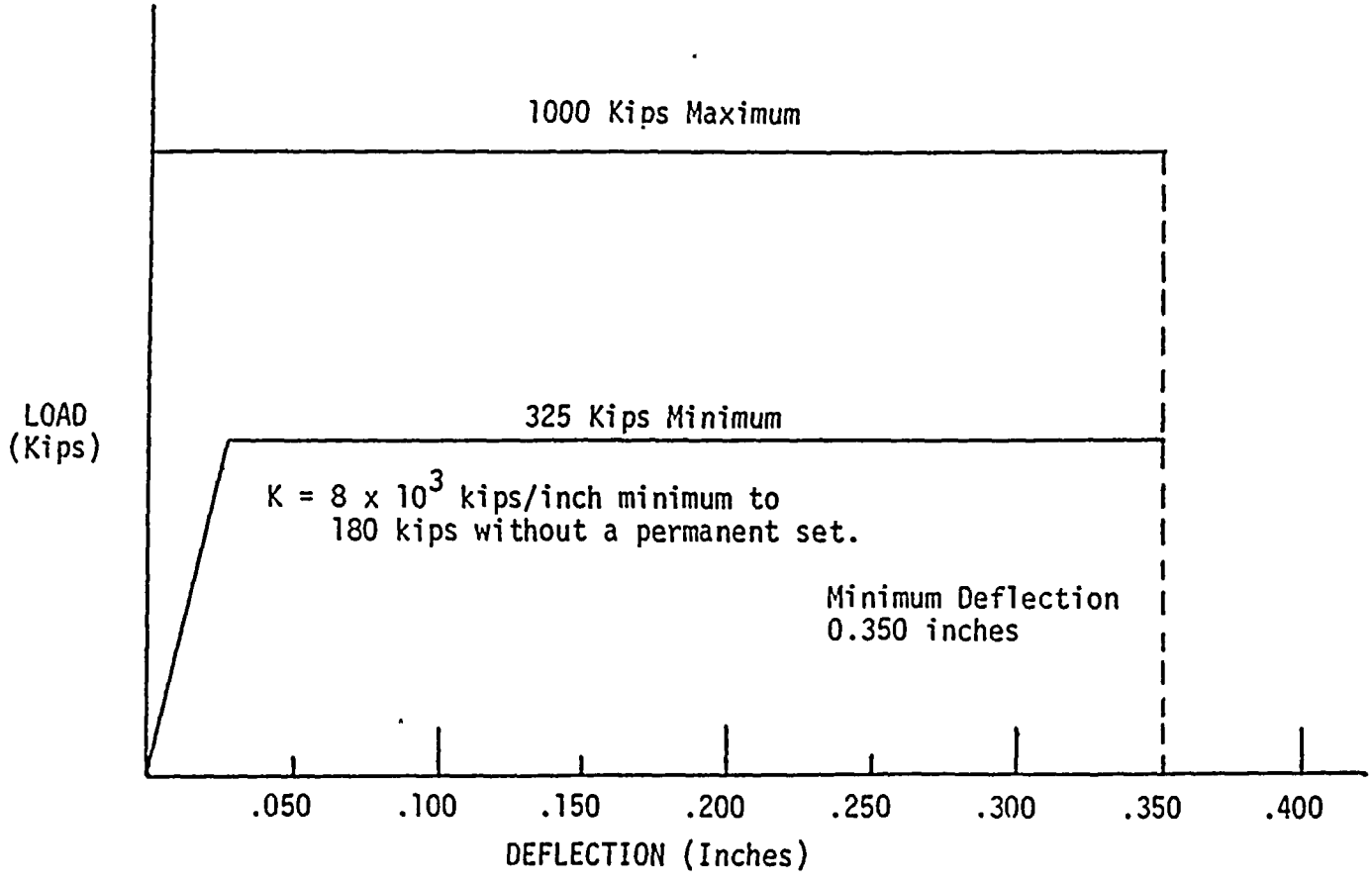


FIGURE 1

HONEYCOMB TEST MATRIX

TEST	SAMPLE SIZE (inches)	SAMPLES	OVEN & PLATTEN* TEMPERATURE °F	CRUSH VELOCITY (inches/second)
1	3 x 3 x .813	3-11 3-12 3-10	400	0
2	2 x 2 x .813	2-12 2-7 2-8	200	0
3	2 x 2 x .813	2-11 2-1 2-3	200	10
4	3 x 3 x .813	3-1 3-3 3-4	200	10
5	2 x 2 x .813	2-2 2-4 2-5	200	15
6	3 x 3 x .813	3-A 3-B 3-C	200	5
7**	3 x 3 x .813	3-14 3-15 3-D	200	10

* Temperature Tolerance was $\pm$ 5°F

** Repeat of Test 4

FIGURE 2