Commonwealth Edison Company
1400 Opus Place
Downers Grove, IL 60515

ComEd

September 22, 1995

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: Additional Information Regarding Commonwealth Edison Company's Request to Increase the Steam Generator Tube Interim Plugging Criteria for:

Byron Nuclear Power Station, Unit 1
Facility Operating License NPF-37
NRC Docket No. 50-454

Braidwood Nuclear Power Station, Unit 1
Facility Operating License NPF-72
NRC Docket No. 50-456

Ladies and Gentlemen:

Commonwealth Edison Company (ComEd) has performed an initial review of the Oak Ridge National Laboratory (ORNL) RELAP5 Mod 3 (RELAP5M3) computer model used to predict hydrodynamic loads across the steam generator (SG) tube support plates (TSPs) during main steam line break (MSLB) conditions. ComEd's comments and observations are documented in Enclosure 1.

ComEd has also converted its RELAP5 Mod 2 (RELAP5M2) computer model to RELAP5M3. Several test cases have been run with the RELAP5M3 model. The initial results of two of these test cases are summarized in Enclosure 2. The results indicate a spike which occurs approximately one second into the event. ComEd is actively evaluating the validity of this spike. ComEd will notify the United States Nuclear Regulatory Commission (USNRC) Staff as soon as any additional information becomes available.

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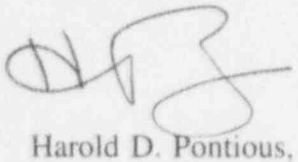
Additionally, ComEd acquired the MB-2 data during the week of September 18, 1995. ComEd is in the process of converting that data to benchmark RELAP5M3.

Furthermore, ComEd has directed Westinghouse to input the RELAP5M3 spectrum into their displacement analysis model. ComEd expects to receive the results of this calculation to be available the week of September 25, 1995. With the successful completion of this calculation, ComEd will submit RELAP5M3 to replace the TRANFLO as the basis for predicting hydrodynamic loads across the SG TSPs during MSLB conditions.

Please address any comments or questions regarding this matter to this office.

Very truly yours,



Harold D. Pontious, Jr.
Nuclear Licensing Administrator

Enclosures

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Enclosure 1

Review Comments on ORNL RELAP5M3 Model of the Byron/Braidwood D4 SG

ComEd has performed an initial review of the ORNL RELAP5M3 model provided and have the following comments and observations. In addition, the ComEd RELAP5M2 model has been converted to Mod3 and preliminary work has been performed to quantify the effects of modelling assumptions utilized by ORNL.

1. The ORNL model used zeros for all the volume control words in the tube regions. Letting b=0 causes the code to select a pipe based correlation for interphase drag calculation.

The code manuals suggest that "b" should be set to 1 for rodded bundles and or SG tube regions, to select the EPRI (Chexal/Lellouche) correlation for drag prediction. This is also discussed in detail in the April-June 1995 RELAP5 Newsletter in the user guideline section item 2, "Modelling Grid Spacers". The result of using b=0 will be unrealistically low interphase friction losses, which will cause higher than expected loads on the tube support plates.

2. The ORNL model used minimum values for the junction hydraulic diameters as entered on the CCFL cards. While this is conservative for CCFL prediction, it affects the interphase drag predictions.

The appropriate values for junction hydraulic diameters on these cards are to use the bundle hydraulic diameter, as per the Newsletter item referred to above. In addition per the Newsletter, the junction areas in the tube region should be increased to equal that of the bundle, with the loss coefficients increased by the ratio of the areas squared to account for the TSP losses.

3. The ORNL model used the CCFL correlations switched "on" for the tube bundle junctions. The RELAP5M3 User's Guidelines indicate (in Section 3.3.2 "Junction - Related Options") that the CCFL model should generally be "reserved for situations where CCFL phenomena are expected".

In our response to RAI question 47, we provided our bases for why CCFL phenomena are not expected, which would support not employing the CCFL model in this case. In addition, a review of the bases of the CCFL models in RELAP5M3 indicate that the models were incorporated primarily to enhance the code's ability to predict post-blowdown flooding phenomena. We do not believe it is appropriate to use this model in the initial blowdown phase of the MSLB transient.

Enclosure 2

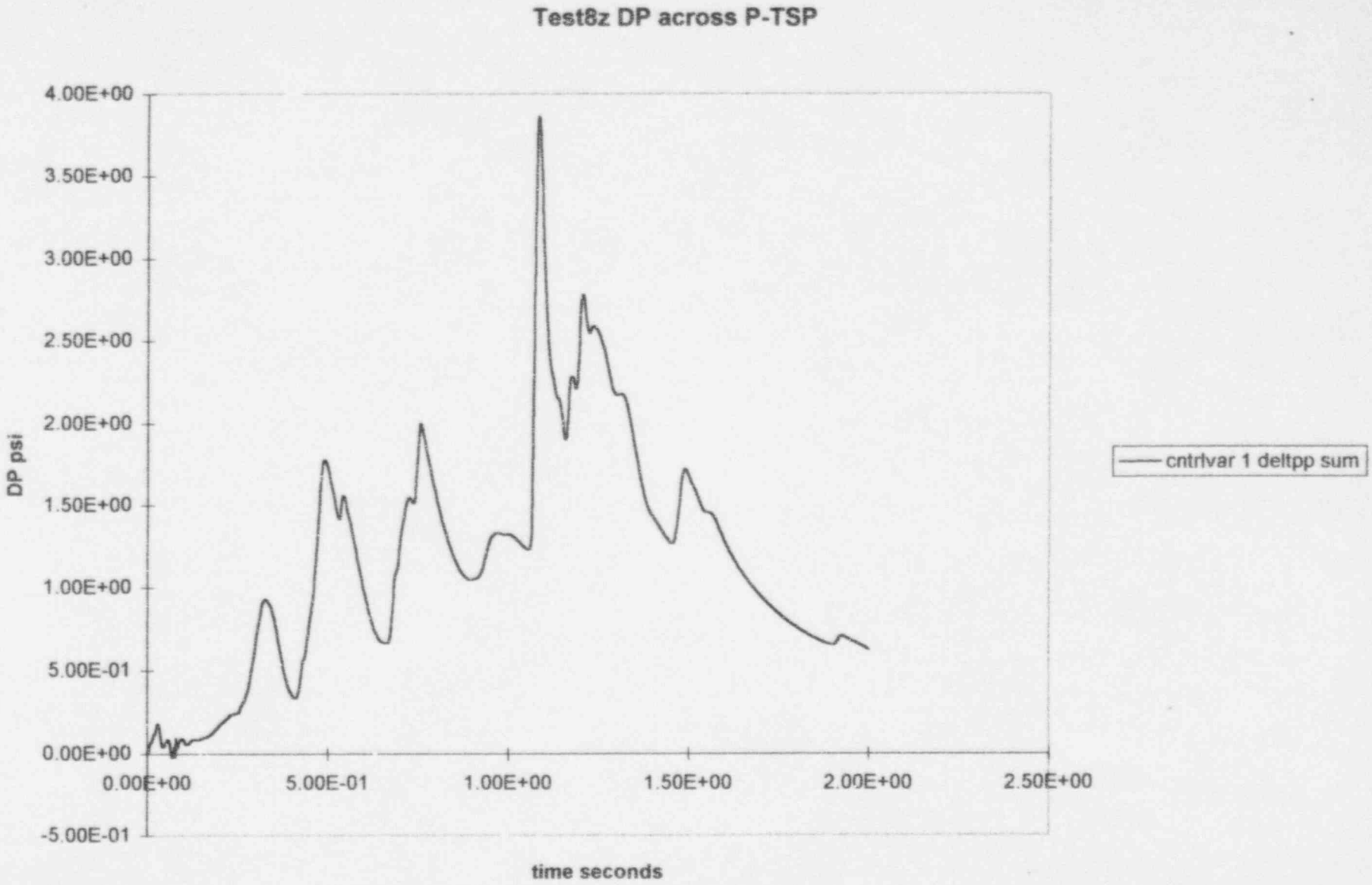
Summary of ComEd RELAP5M3 Analysis Efforts

The base model created in PSA-B-95-11 has been converted to Mod 3 format and exercised. Preliminary work has shown that the loads calculated by Mod 3 are not greatly different than those predicted by RELAP5M2. The ComEd model has been adjusted to follow the guidance in the INEL generated RELAP5 newsletter (April-June 1995) with respect to the modeling of the tube support plates (TSPs) in the tube regions of the model. In addition, the junctions throughout the model have been reviewed for proper input of junction hydraulic diameter to ensure that appropriate interphase drag losses are predicted. One other change that was made was to disable the vertical stratification model in the upper regions of the steam generator, above the separator. This was done following an observation that the swollen mixture/separator carryover appeared to be requiring excessive time to reach the break.

Two cases are presented here for information. These are cases 8z and 9z. These cases are the identical model as described above, but with time steps of 0.0005 and 0.0001 seconds, respectively. The differential pressure predicted on P-TSP for the two cases are shown in the attached figures. It is apparent that a spike is occurring at approximately 1.1 seconds. Plots of the fluid velocity in the lower riser region are also provided. From inspection of these plots, it appears that the spike is closely related to flow reversal in the lower portion of the steam generator. The flow reversal may be resulting in discontinuous behavior relative to the interphase drag correlations and or the prediction of interphase mass transfer area, both of which could result in the numerical aberration observed. That the spike is caused by a discontinuity is reinforced by the performance of cases at differing time steps. A review of the code Models and Correlations (Volume IV) indicates that some compromises were made in the development/inclusion of interphase drag models, that may be a factor in this problem. While we are still investigating the basis of the spike, it is apparent that this value is not a significant load causing element to the TSP, if for no reason other than the very high frequency of the load.

Based on the above discussion, we would conclude that the relevant applied load on the P-TSP indicated by the RELAP5M3 model is approximately 2 to 2.5 psi. This is fairly consistent with the development of loads with other codes and calculational methods, which depending on the level of conservatism included, ranged from 1.6 to 3.7 psi. The structural calculations performed to date were based on an applied load of 3.2 psi, which bound these RELAP5M3 calculated loads in all areas except the peak "spike" still being investigated.

The "spiking" behavior has been discussed with INEL RELAP5 code maintenance personnel. As a participating RELAP5 Newsletter Member, ComEd has prepared and submitted a User Problem/Code Deficiency Reporting Form and applicable basedeck to the INEL code maintenance section. We will apprise you of the results of the investigation as soon as it is completed.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2.50E+00
2.00E+00
1.50E+00
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5.00E-01
0.00E+00
-5.00E-01
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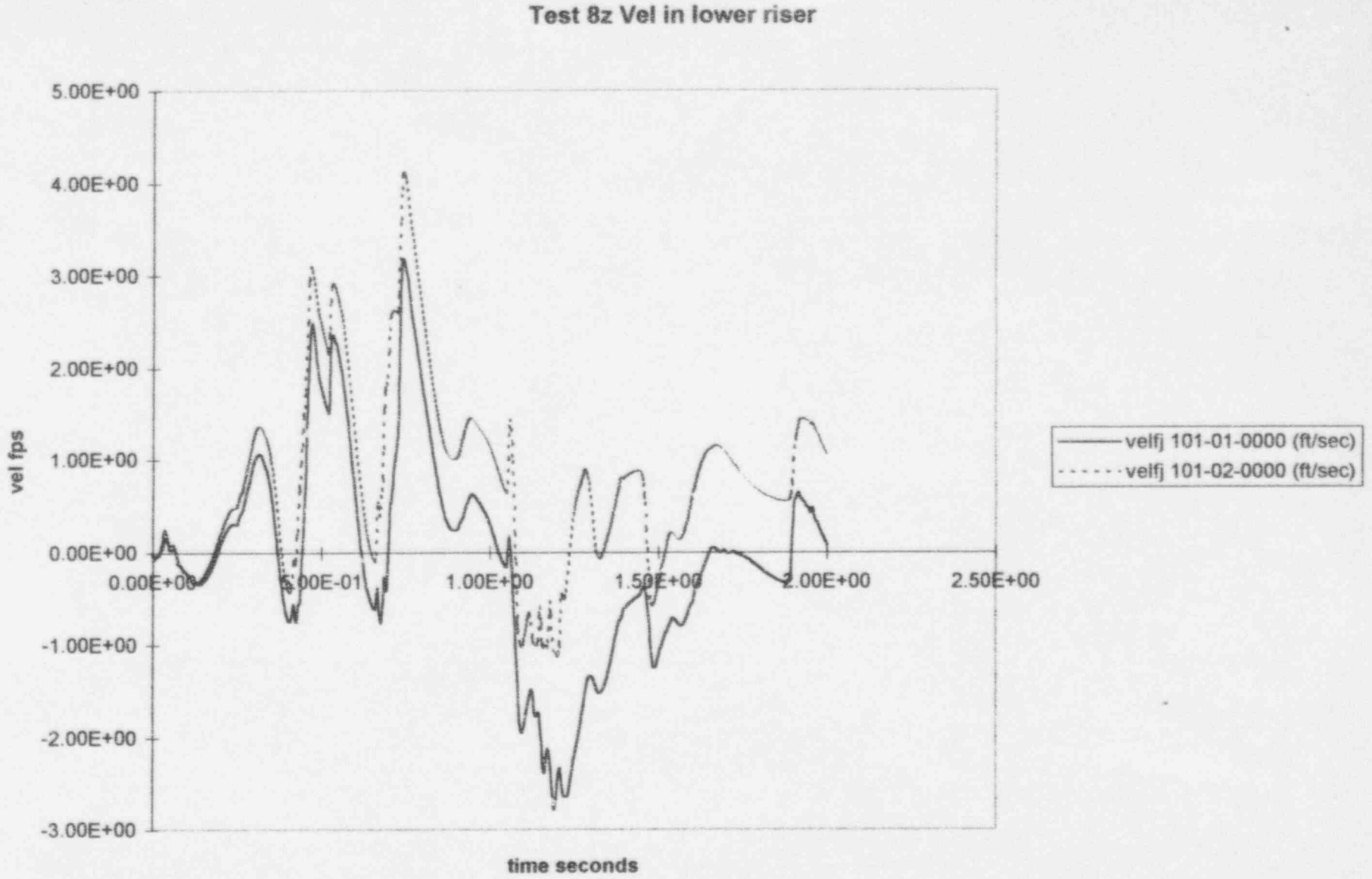
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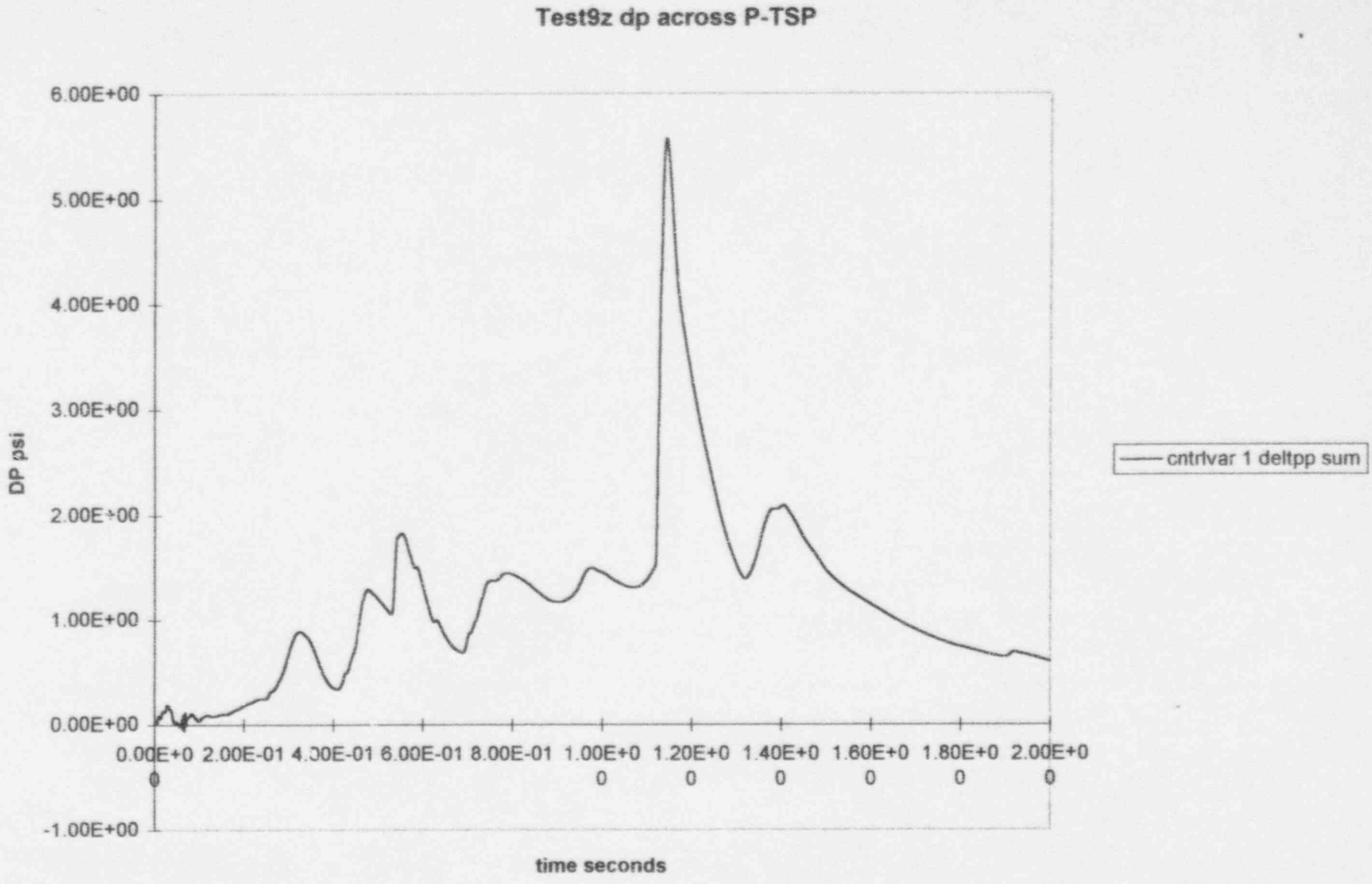
3.00E+00
2.00E+00
1.00E+00
0.00E+00
-1.00E+00
-2.00E+00
-3.00E+00
vel fps
0.00E+00
5.00E-01
1.00E+00
1.50E+00
2.00E+00
2.50E+00
time seconds
velfj 101-01-0000 (ft/sec)
velfj 101-02-0000 (ft/sec)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4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
-1.00E+00
DP psi
0.00E+0 2.00E-01 4.00E-01 6.00E-01 8.00E-01 1.00E+0 1.20E+0 1.40E+0 1.60E+0 1.80E+0 2.00E+0
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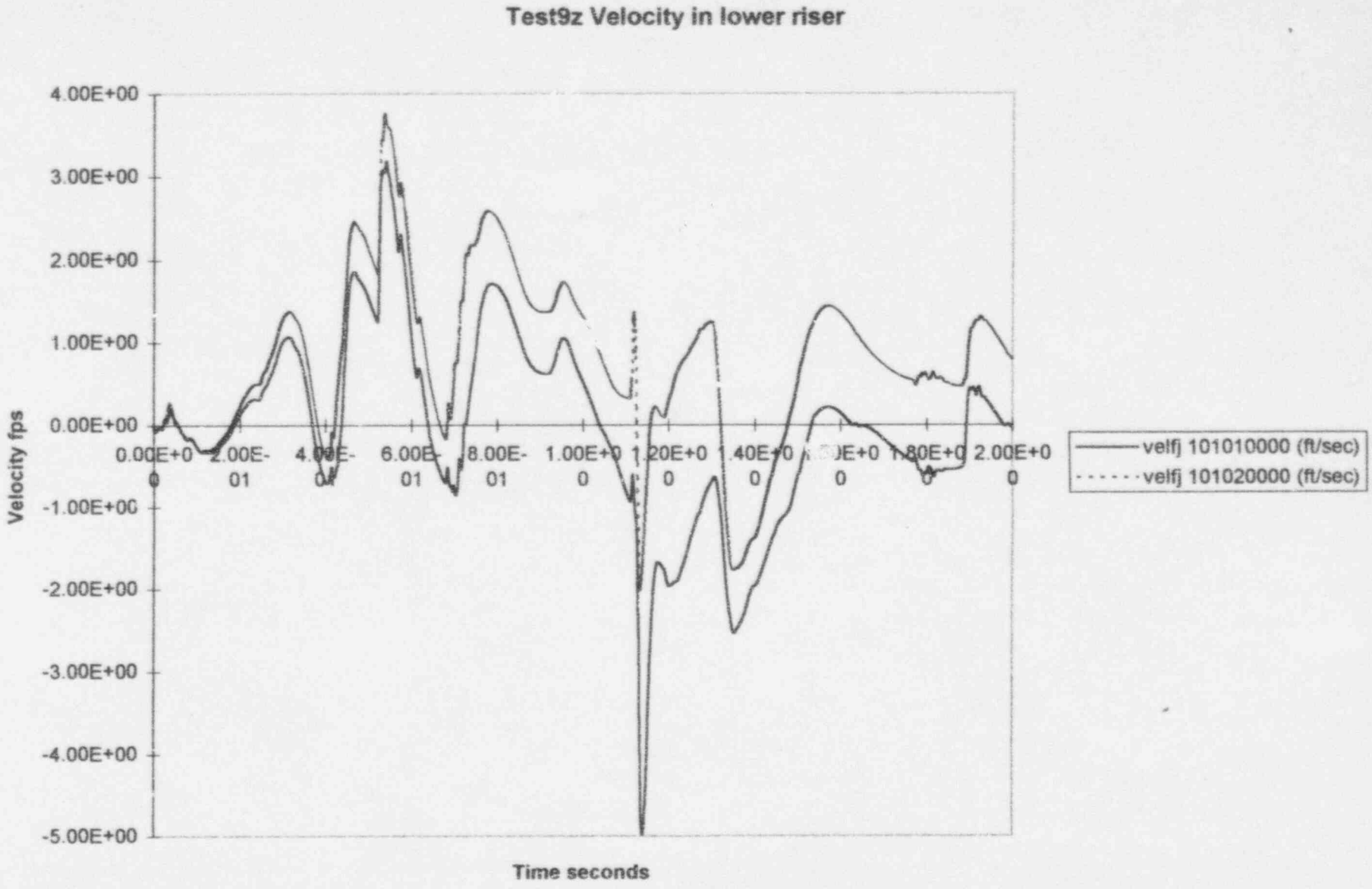
Test9z Velocity in lower riser
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
-1.00E+00
-2.00E+00
-3.00E+00
-4.00E+00
-5.00E+00
Velocity fps
0.00E+0
2.00E-01
4.00E-01
6.00E-01
8.00E-01
1.00E+0
1.20E+0
1.40E+0
1.80E+0
2.00E+0
Time seconds
velfj 101010000 (ft/sec)
velfj 101020000 (ft/sec)