Improvements to the Pressurizer Component
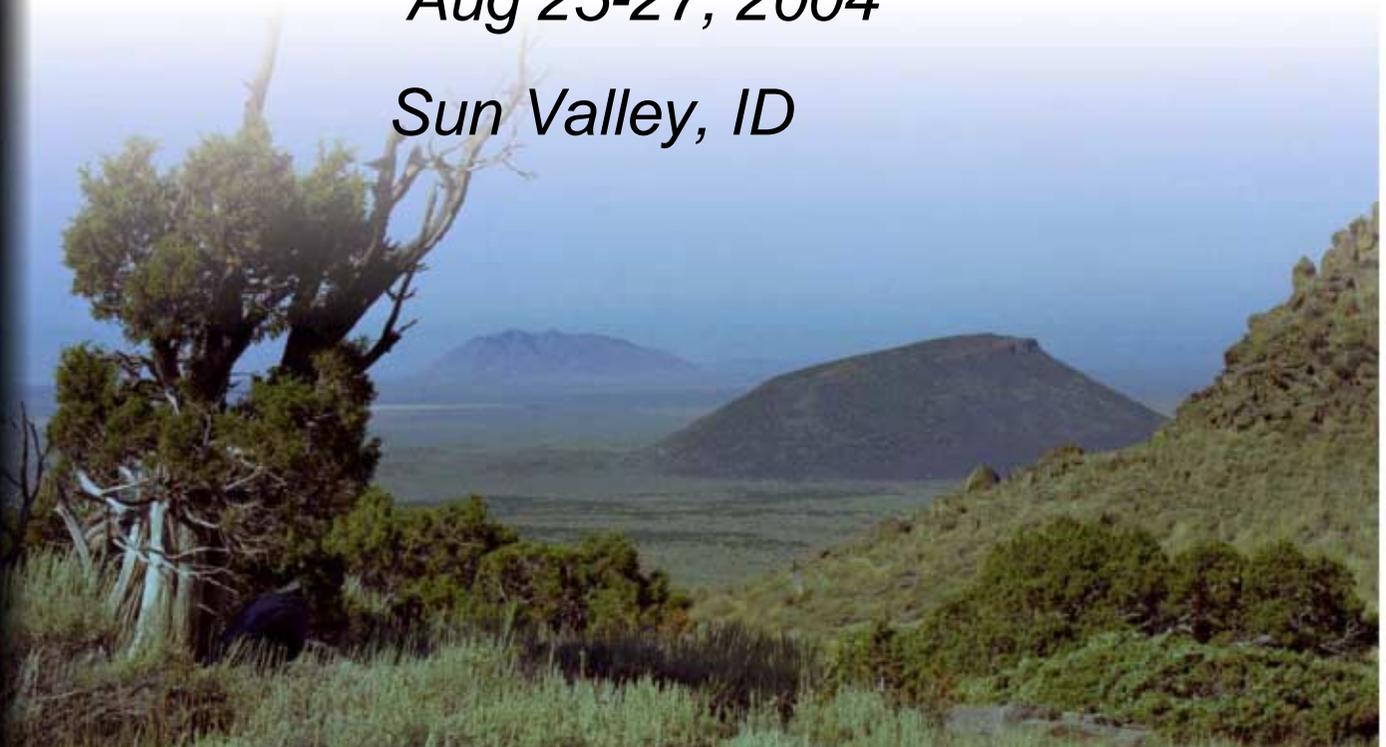
Walter Weaver

2004 IRUG Meeting

Aug 25-27, 2004

Sun Valley, ID

Outline

- **Background**

- **Improvements to the pressurizer component**

- **Test results**

- **Summary**

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# Background

- *Pressurizer component based on pipe component*

- *Special two-phase level and interfacial heat transfer models*

- *Generally poor comparisons with data*

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Neptunus Pressurizer Test

- *Neptunus pressurizer test facility at Delft University*

- *1/40 volume scaled test facility*

- *Test Y05 used flow insurges and outsurges through surge line at bottom of test vessel with pressurizer spray into top of vessel*

- *Test used to assess RELAP5/MOD1 and TRAC-PF1/MOD1*

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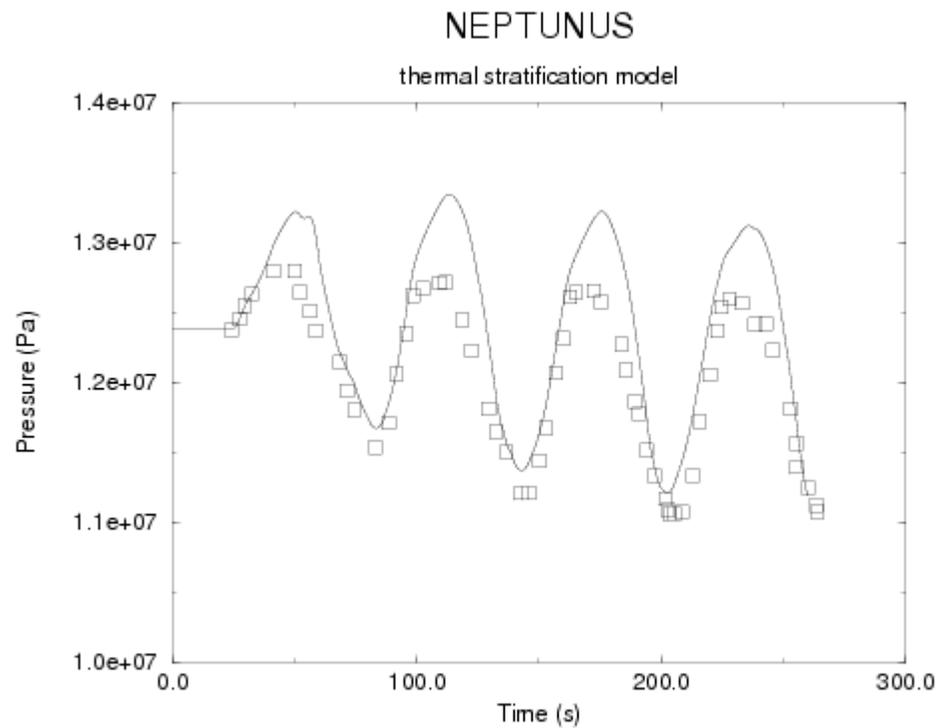# *Neptunus Pressurizer Test Results*

Neptunus Pressurizer Test Results (cont.)

INEEL
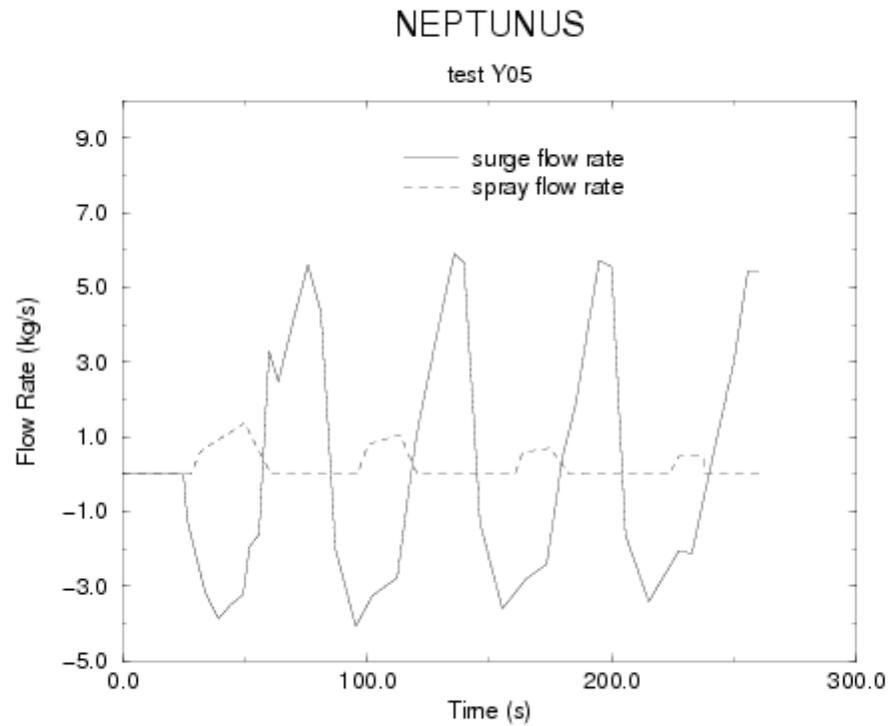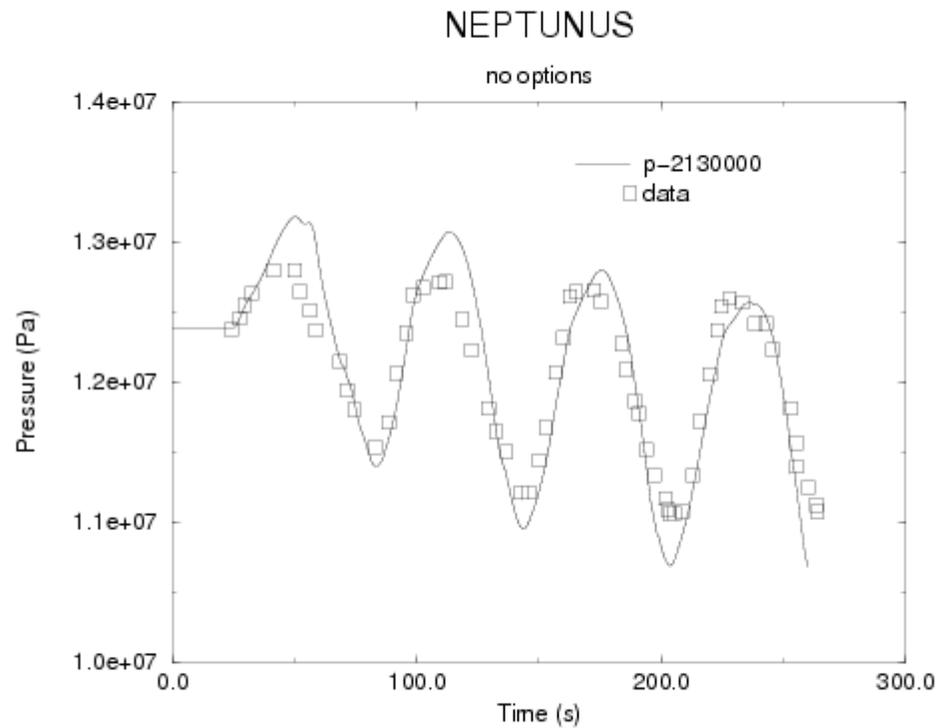
Neptunus Pressurizer Test Results (cont.)

- *Several modeling options were tried*

  - thermal front tracking model activated, improved pressure agreement during outsurges

 *- two-phase level tracking model activated, pressure too high during insurges*

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Neptunus Pressurizer Test Results (cont.)

NEPTUNUS

thermal stratification model

Improvements to Pressurizer Condensation Model

- **Several options added to modify interfacial condensation model**

  - multipliers on existing interfacial heat transfer coefficients

  - user input interfacial heat transfer coefficients

  - user input spray droplet size

  - user modification to fraction of available liquid in film on surfaces

- **Slight improvement to pressurizer response**

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Neptunus Pressurizer Test Results (cont.)
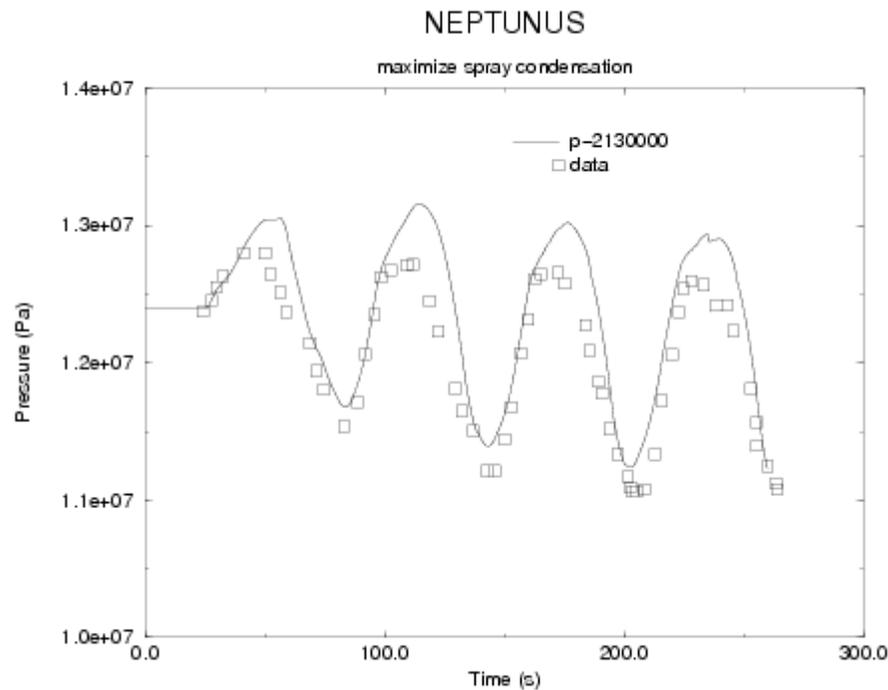
Improvements to Pressurizer Condensation Model (cont.)

- *Examination of literature on pressurizer behavior revealed a spray induced enhancement to interfacial condensation*

- *During insurge events, a thin saturated layer of water on top of pool inhibits condensation on pool surface*

- *Spray droplets disrupt pool surface exposing subcooled liquid in pool, enhancing condensation*

- *Enhanced condensation rate a function of spray impingement rate on pool surface*

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Improvements to Pressurizer Condensation Model (cont.)

- **Spray impingement flow rate computed as total downflow rate of liquid at surface of pool minus integral of condensation rate on wall surfaces above pool**

- **Enhanced condensation rate product of spray impingement rate, ratio of pool subcooling to heat of vaporization, and a user input constant**

- **User input constant specifies the amount of mixing between spray liquid and pool liquid**

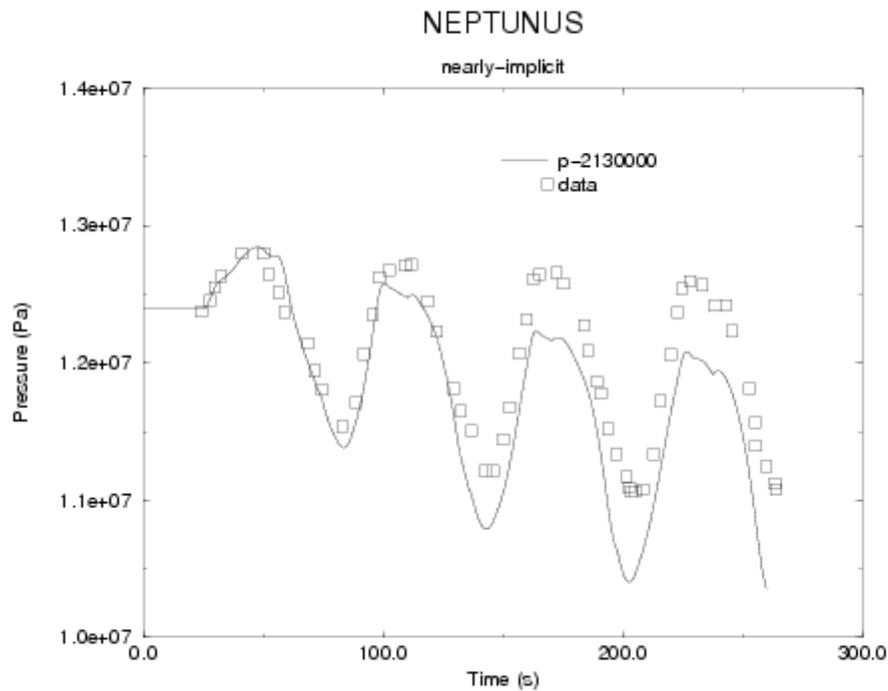- **Model only activated when flow activated in spray junction**
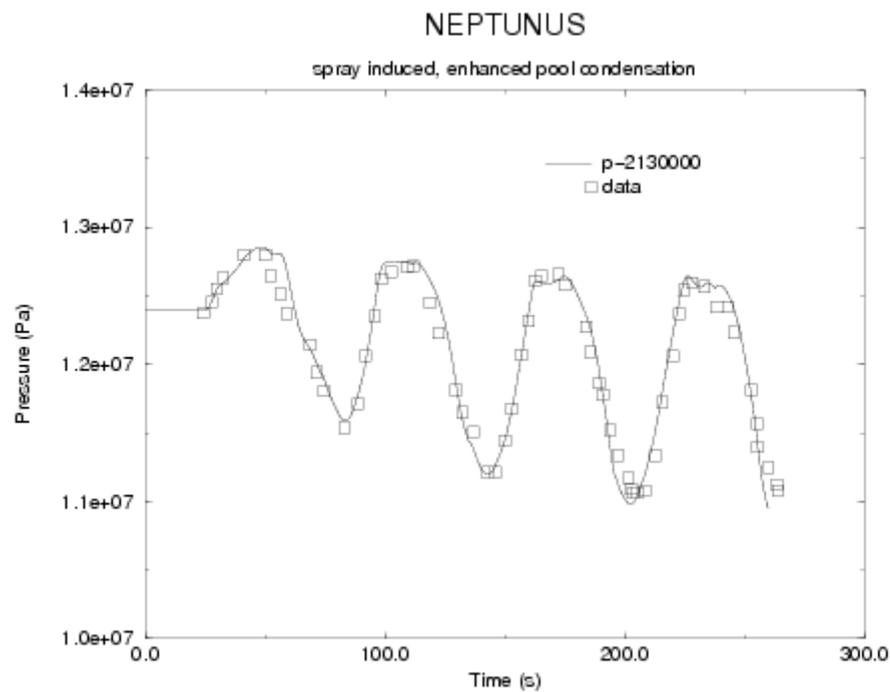
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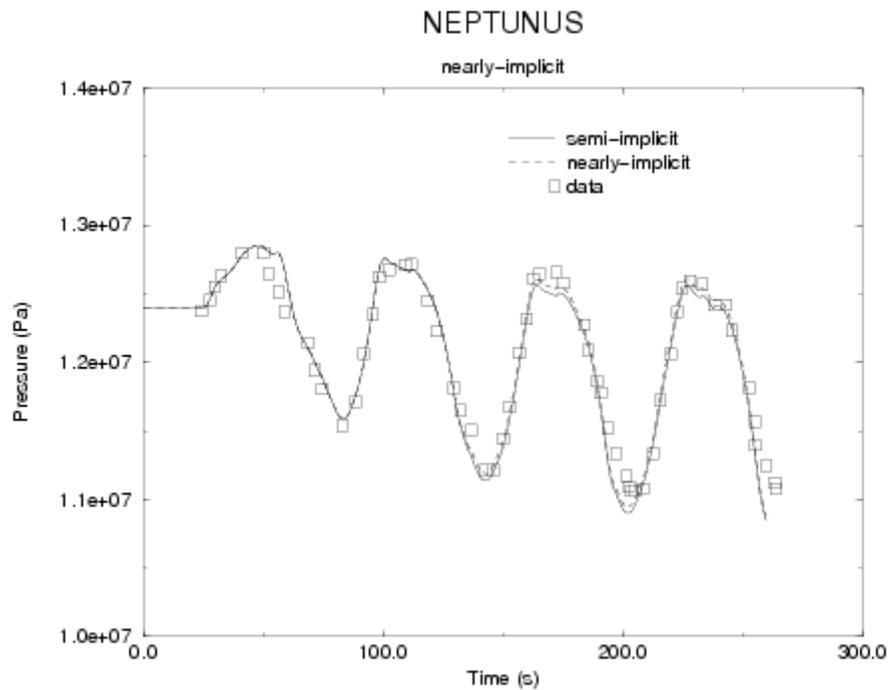# *Neptunus Pressurizer Test Results*

Neptunus Pressurizer Test Results (cont.)

Neptunus Pressurizer Test Results (cont.)

Neptunus Pressurizer Test Results (cont.)

INEEL
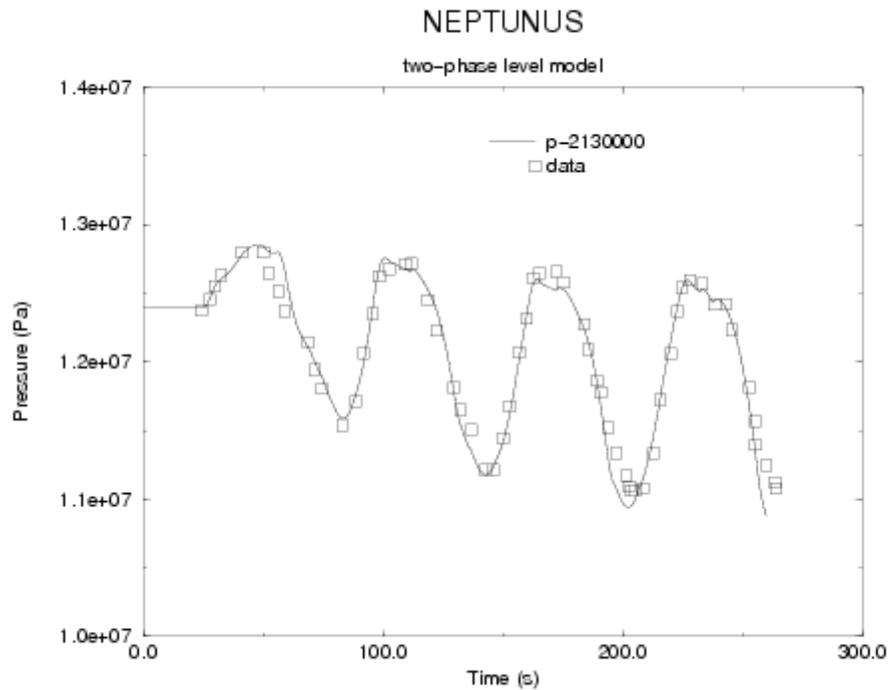
Summary

- *New pressurizer condensation model implemented*

- *Dramatic improvement on pressurizer response*

- *Thermal stratification model implimented for nearly-implicit solution algorithm*

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