Selected User Problem Resolutions

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The resolutions for two legacy and four recent user problems are described and explained.

Introduction

Various older user problems were resolved in the last quarter. Some of the highlighted fixes include user problems 13018, 15027, 16027, 16028, 16031, and 16032. Each problem is identified by User Problem (UP) number and date recorded, followed by a detailed description, followed by comments about the work (if more involved than normal), and finally concluded with the status. All problems reported here were resolved by Nolan A. Anderson (NAA). The problems reported are:

1. Level stack connection rule violation
2. Decoupled heat structures affected hydraulics time step
3. CCFL model error when using the abrupt area change model under certain circumstances
4. CCFL model exhibits a large sensitivity to time step size
5. Second restart error involving compressor
6. Some DA problems failed to run using h2o95

The Selected User Problems

1. UP 13018 from 4/2013

- DESCRIPTION: An input file was created that tests the level stack connection rules contained in Volume 1 of the code manual. The problem contains two parallel pipes, each of which uses the mixture level tracking model. A junction is used to connect the two parallel pipes. The problem simulates 36 cases that test each possible combination of from/to face connections. The number of level stacks calculated by the code disagrees with the connection rules contained in the manual for 10 of the 36 cases. The code logic should be modified to be consistent with the code manual or the manual should be corrected to accurately describe the actual connection rules.
- STATUS: RESOLVED (NAA): The level model coding was modified to correctly calculate the number of levels for each of the input cases. The changes were reviewed and tested on various input cases to determine their effect. The problem is resolved.

2. (UP 15027, 7/15)

- DESCRIPTION: A Seabrook model gives different answers at steady state when two decoupled heat structures (geometries 8502 and 8503) are added to the model. Specifically, the number of time steps and mass errors differs at the end of the run. No differences were expected since decoupled heat structures should not affect the hydraulics. The decoupled heat structures use the cladding deformation model and this is likely the cause of the problem. The cladding deformation model affects the flow area in the volume and hence the hydraulics. For a decoupled heat structure, the cladding deformation should be calculated, but the deformation should not result in a change in the volume flow area.
- STATUS: RESOLVED (NAA) Modified the coding that calculates the area change due to deformation such that the contribution from decoupled heat structures is not included in the calculation. The answers with and without the decoupled structures now show no difference in the hydraulics calculations.

3. (UP 16027, 10/16)

- DESCRIPTION: The CCFL model does not work correctly when the abrupt area change option is used and the input area at the junction is less than the minimum of the two adjacent volumes. This problem was reported previously (UP-07030), but the code has not been changed nor has the manual been updated so that the user can input a constant that accounts for the code error. The root cause of the problem is that the superficial velocities used in the CCFL model are calculated based on velfj and velgj. These velocities are correctly based on the input junction area when the smooth area change is used. However, when the abrupt area change model is used, velfj and velgj are based on the minimum of the two adjacent volumes rather than the input junction area. The correct solution is to divide velfj and velgj by the junction throat ratio when the abrupt area change model is used or to provide guidance to the user to alter the input constant C for the flooding equation. The correct value of C to enter when the abrupt area change is used at a restriction, such as the upper tie plate, is the desired value of C times the square root of the input junction area divided by the minimum area of the two adjacent volumes.
- This problem is illustrated by duklererr.i, which is based on the Dukler DA problem except that the problem was changed to represent steam/water at 7.0 MPa so that the results would be smoother than the original DA problem and the area at junction 10501000 was changed from 0.00203 m2 to 0.001 m2. When the steam flow in time-dependent junction 103 is input at 0.02 kg/s, the steam flow at Junction 105010000 at 100 s is 0.0232 kg/s when the smooth area change is used. The calculated liquid downflow rate at 100 s (0.0635 kg/s) is consistent with the solution to the Wallis flooding equation when C = 0.88 and m = 1. If the abrupt area change model is used, the calculated downflow rate of liquid is much higher (0.166 kg/s) because the code's calculation of the steam superficial velocity is too low. If the constant is changed to 0.88 x sqrt(0.001/0.00203) = 0.6176, the code gets the same downflow as with the smooth area change and C = 0.88.
- STATUS: RESOLVED (NAA): Modified the coding so that the constant C is modified when the abrupt area change model is in use. With this modification the junction velocity is the same for the first two cases of the test problem. The modification to the constant in input is no longer necessary to obtain the correct flow rate.

4. (UP 16028, 10/16)

- DESCRIPTION: The CCFL model exhibits a large sensitivity to time step size. The test case described above is similar to the one submitted for UP 16027, except that the steam flow rate was changed from 0.02 kg/s to 0.03 kg/s. The code's solution to the flooding equation yields no downflow of liquid at 100 s. However, the correct solution is a downflow of about 0.04 kg/s. When the time step is reduced from 0.025 s to 0.01 s, the code gets the correct solution. If the time step is too big, the code appears to predict no downflow, even when the flooding equation allows some downflow.
- STATUS: IN-WORK (NAA): Modified the code so that the test for whether the ccfl model is on is based on the velocity at the previous time step instead of an intermediate value. With this change the results roughly lie on top of each other with the two used time step sizes. However there is some oscillation in the results which should be smoothed out. The problem is only partially completed.

5. (UP 16031, 11/16)

- DESCRIPTION: A second restart problem fails when initializing with an error message that says "Wrong information in restart record header". In looking further at the issue the problem does not appear to be reading the proper input.
- STATUS: RESOLVED (NAA): Found that the number of restart records read for the compressor component was incorrect, which resulted in a failure. Modified the number of reads performed to the correct value, which corrected this problem.

6. (UP 16032, 11/16)

- DESCRIPTION: In testing the h2o95n fluid as compared to h2o95. The following problems from the DA failed to run using h2o95.
  uptf131_21p.i, uptf131_21p_pipe.i, and all dukler input decks (100,250,500,1000) had errors during input processing which were not flagged with h2on or h2o95n.
- Test cases l2-5_1D.i, l2-5_3D.i, and LOBI-A1-4R.i all failed with thermo-property errors - NaN's occur throughout the output. These all ran using h2on and h2o95n.
- STATUS: RESOLVED (NAA): Found that the variable s(index) was set incorrectly in subroutine stntp.F of the envrl directory. Modified the calculation to match how other routines performed it, which corrected the setting of the variable. Also found that the uptf cases were failing because one of the volumes had initial conditions at one of the pressure points. To correct this looked at how the h2o fluid interpolators handled the issue. Found that the two interpolators were following slightly different logic paths, which resulted in the failure for the h2o95 cases. Modified an if test to test for greater than instead of greater than or equal to, which corrected the issue for all of the listed cases.