Description of DOE-2.2 version 44c3 Bugfixes that Affect Title 24 Analysis:

1. The calculations for the change in extraction rate with zone temperature omitted the 0.5 factor in the X, Y, Z terms for the PVVT subzone case only. For those subzones this results in small changes in the max/min extraction rates (typically <1%), and small changes in hourly zone temperature (typically < 0.5F). Net effect on annual heat/cool energy is << 0.1% per zone.
2. In Dual Duct system problems with redistribution of HSUPPLY-FLOW were fixed. 1) If all ZONE's had their HASSIGNED-CFM specified the SYSTEM was getting zero OA (but OA is always wrong being low by the amount for ZONEs with A-CFM specified.) This can happen if the heating flow CFMAXH had to be made greater than the HASSIGNED-CFM due to the box min flow being larger than the assigned heating flow; this can happen when the MIN-CFM-RATIO time the maximum box flow (minus the CMIN-CFM-RATIO x cooling flow) is greater than the HASSIGNED-FLOW. 2) Also fix a bug related to the redistribution of SUPPLY-CFM out to ZONEs not having ASSIGNED-CFM specified; the amount being distributed out was not accounting for the SIZING-RATIO.
3. Fixed a problem with redistribution of SUPPLY-CFM to zones. In case when a ZONE ASSIGNED-CFM was specified the entire redistribution calculation was skipped, thus the summation of that ZONE's OA into the SYSTEM total OA was also skipped. In this case SYSTEM OA total is always wrong being low by the amount for ZONEs with ASSIGNED-CFM specified unless MIN-OUTSIDE-AIR was used (SYSTEM level) rather than ZONE keywords.
4. Fixed a problem with air-to-air heat pump formulations. The defrost calculation assumes that the defrost mode happens each hour for its full time as if PLRh was 1.0 each hour the heat pump operates in defrost mode; if HP is operating and OA temp < defrost T, the defrost time is independent of HP run time. We changed this method to estimate the HP heat PLR and then reduce the full defrost time by multiplying by the estimated HP heating mode PLR. **NOTE: In the results summary, certification tests involving heat pumps show the largest change in results.**
5. Ver 44c2 in SYSTEMS program: The CONS() variables during a start-up hour were based on an entering coil temperature = 0; this was a bug caused by the use of the previous hour's zeroed value for TM. This was modified to use the last start-up hour's value. Also, Q (the coil enthalpy change) in DDSF (dual duct AHUs) and SDSF (single duct AHUs) was calculated based on a density different than used in establishing the CONS() terms; this created an inconsistency in mass flow rates between the zones and the coil; this was corrected to allow all energy calculations to be based on the same constants during the hour for an AHU and its attached zones with an overall delta on annual energy being less than 0.5% (however, the delta on peaks may be larger.)

Description of DOE-2.2 version 44c3 Bugfixes that do not Affect Title 24 Analysis:

1. Replace the mod in -044b1 for duct losses to unconditioned zones with a more general solution. Results should be identical. Hourly reports for HENOW, ERMAX, ERMIN, ERMAXM will be different, as these terms now include pipe/duct losses, rather than just representing active heating/cooling extraction.
2. Fixed bug in fan/heat/cool schedules that can have negative values. For example, if optimum start feature is used and the fan schedule has more than 6 -999's in a sequence, the FON on flag gets set to 999 rather than 0, which causes the fan to be on rather than off and FON is used as an on/off multiplier on some flows (especially in dual duct (DDS/MZS/PMZS) systems - this causes the result for that hour to be junk (999 times to high flows that can cause negative electric and gas consumptions).
3. Fixed a bug in crankcase heater energy calculation for the case of MIN-HGB-RATIO = 0.0 (default for PVVT and RESVVT) and also for all PMZS cases. When MIN-HGB-RATIO is zero the compressor runs for the entire hour if PLR > 0, thus crankcase heater does not run at all; code incorrectly had crankcase heater running for (1-PLR) fraction of the hour; for PMZS the crankcase heater ran for (1-plr) fraction of the hour independent of the MIN-HGB-RATIO value.
4. Added numerous Error/Warning messages and new sizing calculation for OA-FROM-SYSTEM referenced SYSTEMs. Previously, if a SYSTEM had an OA-FROM-SYSTEM specified, its MIN-OUTSIDE-AIR was reset to the MIN-OUTSIDE-AIR of the referenced OA-FROM-SYSTEM; this has been removed and replaced with the opposite action; the sum of the OA requirements for all SYSTEMs that reference an OA-FROM-SYSTEM is used to set the OA-FROM-SYSTEM MIN-OUTSIDE-AIR, SUPPLY-FLOW and adjust its ZONEs flows and minimum flows for both heating and cooling. Additionally the OA-FROM-SYSTEM has its calculated/specified cooling (total and sensible), heating, and preheat capacities adjusted if its SUPPLY flow was increased. If the OA-FROM-SYSTEM and its ZONEs have sufficient minimum OA specified (greater than that required by the referencing SYSTEMs) no adjustments are made. If any adjustments are made a warning is issued that informs the user of the adjustments and recommends the project be re-run with the values in the input corrected. Also, errors are issued (and the simulation terminated) if the OA-FROM-SYSTEM is either an incorrect type (a zonal system or a system that cannot have outside air) or the OA-FROM-SYSTEM is not placed into the input file before any referencing SYSTEM.
5. Fixed three inter-related issues relating to primary/secondary CIRCULATION loop interactions. 1) An expression sets the secondary valve type, when to specified by the user, to 0 when no secondary pump is specified; in the hourly calculation this 0 was not handled correctly. The result is that the primary pump “sees” constant flow from the secondary loop, in cases when it was specified to be variable. 2) During the hour a loop starts, the start-up calculations for a secondary loop did not take into account the correct loop thermal loss dT when calculating the required supply temperature. An entering CHW coil temperature could be unrealistically high, and exceed the limits of the coil temperature curve; this could

result in the termination of the simulation (crash) with an X**Y where Y is non-integer and X < 0 error message. 3) During a start-up hour, a check was added to determine whether the coil loads are large enough to make the loop temperature float away from setpoint and make appropriate calculation adjustments as needed. Chiller energy may increase by 1% on an annual basis as a result of these changes in projects that were running into these problems (mostly when the primary loop was incorrectly undersized relative to connected variable flow secondary loops.)

6. Ver 44c1 in SYSTEMS program: Added PLRCC (compressor cooling PLR) as system report-block item 154. Added PCH (fraction of cooling air in dual duct systems that "wipes" the heating coil before going to the cold deck) as system report-block item 202. Added ISZCZ (single zone system control zone, 1=yes, 0=no) as system report-block item 203. Fixed a bug in reporting of fan power for fan coils in ZONEs with a MULTIPLIER or FLOOR-MULTIPLIER not equal to 1.0; in this case the SS-L report value was correct but the value placed on the meter (and thus PS-E/F, ES-x and BEPS reports was not including the multipliers.
7. Ver 44c2 in PLANT program: Fixed a bug that caused the waterside economizer to crash due to a negative loop flow when attached to a LAKE/WELL loop; no impact on simulation results. Increased maximum number of secondary loops that can be attached to a primary loop from 20 to 50.
8. Ver 44c2 in SYSTEMS program: The default design minimum CFM ratio for heating mode in AHUs was not adjusted when the SUPPLY-CFM was user-specified and zonal flows were all reallocated; negligible impact on heating/cooling energy.
9. Ver 44c3 in SYSTEMS program: Activated VAV heating mode for PVVT systems; allow heating mode CFM for PVVT systems to be less than cooling CFM. Changed a calculation logic in the sub-zone (those that are not CONTROL-ZONEs) in PVVT systems relating to VAV heating flow. If the control zone is in the heating mode ensure that all sub-zones are also using their heating mode flow rates. Prior to this change the sub-zone flow minimum was being set by its temperature relative to its thermostat setpoint, thus if the control zone was in the heating mode but the sub-zone temperature put it into cooling, it would use its cooling min flow rather than heating min flow - in the case that the cooling min flow is above the heating min flow the zone temperature would be further forced up and the fan flow would be too high. This was causing an over estimate of heating energy and heating mode fan energy that could both be significant fractions of the correct amount.
10. Ver 44c3 in SYSTEMS program: Add NATURAL-VENT-KW if present, when venting is active - this allow approximation of whole house fan. Change fan reports to allocate operating power to cooling when evaporative cooler or desiccant system is operating.
11. Ver 44c3 in SYSTEMS program: Fixed a bug in the setting of supply temperature min/max in DKTEMP for single duct systems when the max heating flow is not equal to the min cooling flow and the min cooling flow is <1. In this case the heating coil flowrate was incorrectly getting set to the cooling coil flow rate. This then caused the max heating temp to be incorrect. Usually heating flow was supposed to be lower so the heating temp is underestimated leading to long fan

run times in cycling systems or possible unmet load in constant operation systems.

12. Ver 44c3 in SYSTEMS program: Changed the "insufficient heating" error message to a warning for non-VAV systems; this error/warning is issued when the sum of the baseboard plus air system heating capacity in a zone is less than the zone design load. This remains an error in the case of a VAV system when the thermostat-type is reverse-action. Also fixed other design/sizing errors where the a flag was not getting set to cause a DLL error/termination return back to the interactive application which called the simulation.