A Preliminary Analysis of Subroutines Between MELCOR and SCDAP/RELAP5 Codes For Core Modeling

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1. Introduction

The need for a localized severe accident analysis code is on the rise, and KAERI is developing a severe accident code. In particular, core modeling is expected to be the most important part. Through the investigation of core modeling for the existing severe accident codes, it is planned to design the basic structure for the severe accident code. To invest the existing severe accident codes, MELCOR code (v 1.8.6) and SCDAP/RELAP5 code were chosen as reference codes. It is necessary to analyze two codes, especially for the core part. This paper shows a these preliminary analysis of core part of the MELCOR and SCDAP/RELAP5 code.

2. Analysis of Two Codes

MELCOR code is a fully integrated, engineering-level computer code that models the progression of severe accidents in light water reactor nuclear power plans. And the MELCOR COR package calculates the thermal response of the core and lower plenum internal structures, also models the relocation of core and lower plenum structural materials. SCDAP/RELAP5 code is designed to calculate the severe accident situations of the overall RCS thermal-hydraulic response, core damage progression, reactor vessel heat-up and damage, and fission product release and transport. The MELCOR and SCDAP/RELAP5 codes are enormous codes with many subroutines. Like other simulation codes, in addition to core modeling, they have input processing, initializations, data saving, error handling, plotting, etc. But their implementing method and executions are very different. In this analysis, core modeling subroutines are analyzed for use in the severe accident code.

2.1 MELCOR code

The MELCOR code (v 1.8.4) was analyzed in 2000 [1]. Since the analysis, the MELCOR code has been analyzed continuously.

The core modeling part of the MELCOR code has 254 subroutines named a COR package. They are positioned in an independent sub-directory named 'COR'. Among the subroutines, 100 are major subroutines. The calling sequences and the major functions of their subroutines are analyzed, and the results are descripted as a document. The upper subroutines consist of 8 subroutines: CORRN0, CORRN1, CORRN2, CORRN3, CORRN4, CPRRN5, CORRN6, and CORRNZ. Below the upper subroutines, 88 subroutines are called according to their functions. The upper subroutines are shown in Table 1 with their brief function and lower-part subroutine names.

Table 1: Major subroutines for MELCOR code

Upper subroutines	Functions / Lower-part subroutines
corrn0	Core lower head failure and debris ejection / corlhf
corrn1	Calculates core heat transfer and oxidation / mpmodeos, corgt1, coreu3, cordck, cordhc, elheat, corsrc, corpow, corctk, corgap, corrds, corradcormp, corsub, cormps, cortsv, corcnd, corhtr, coralh, corvpr, corgt1, corcnv, mpthc1, mpvis1, hsboil, hslhx, corvpr, corcnv, cordpq, corstf, corfzs, corlhr, corlhd, coroxx, coroxy, corgeo, cordck, cortub, corfml, coreu3, cords0, corfzs, corfreezestray, corbal
corrn2	Controls the system and subcycle time step and defines the heat transfer rate to each control volume for the next system cycle / (none)
corrn3	Calls the cvh, hs, and rn1 interface routines, communicating energy and mass transfer information to the cvh package, energy transfer information to the hs package, and mass relocation information to the rn1 package. / (none)
corrn4	Controls the modeling of the core degradation and relocation. / corblo, corvls, corcrd, corcrh, corvck, corcb, coreu0, cordck, coreu1, cordrp, coreu2, rn1crr, corgeo, rn1zer, corrbl, corstr, corslu, corsl2, corlay, corm2p, corsnk, corsn2, corspr, corspd, corbal, corfrz, cormix, corstl, cornpv, cords6, corpmx, rn1cmx, rn1zer, dbugit
corrn5	Issue messages to report support failure events that may have occurred on a subcycle basis. / (none)
corrn6	Sets the global energy balance variables in common block corgeb / (none)
corrnz	Update CVH virtual volume data

	from change in fluid volumes in COR. / (none)

2.2 SCDAP/RELAP5 code

The SCDAP/RELAP5 code including the SCDAP/RELAP5 code, was analyzed in 1998 [2]. Based on the document, the SCDAP/RELAP5 code was analyzed in more detail. The major subroutines of the SCDAP/RELAP5 code are positioned in four sub-directories. The number of the subroutines is 444. Initiated in the main program, all sequences of the subroutines are analyzed.

There are 11 major and upper level subroutines for core modeling: DTSTEP, CHKLEV, TRIP, TSTATE, PVMPUT, HTADV, SCDPRH, HYDRO, RKIN, SCDPSH, and CONVAR. Below the major subroutines, several tens of subroutines are called according to their functions. The upper part subroutines are shown in Table 2 with their major function and lower-part subroutine names.

Table 2: Major subroutines for SCDAP/RELAP5 code

Upper subroutines	Functions / Lower-part subroutines
dtstep	Controls time step selection and frequency of output and plotting edits during transient advancement. / ttydirr, timer, dmpcom, mover, sstchk, msgtty, fmessg, mirec, majout, rstrec, pltwrt, ftrans, sqoz, interi, ftrmpa, pvmrcv, pvmsnd, pvmfexit, courn1, cournt, mover
chklev	Controls movenent of two-phase levels between volumes. / level
trip	Tests trip conditions and sets trip conditions and time of trip. / (none)
tstate	Processes time dependent volumes and junctions. / polat, stcset, pvmput, pvmset, sth2x1, std2x1, strtx, sth2x3, std2x3, strtp, sth2x6, std2x6, strpu1, sth2x2, std2x2, strpx, sth2xf, std2xf, strpu2, psatpd, pstpd2, strsat
pvmput	Places data from pvmrcv into time dependent volumes and junctions. / (none)
htadv	Controls advancement of heat structures and computes heat added to hydrodynamic volumes. / radht, qfmove, ht1tdp
scdpph	Controls advancement of scdap before call to hydro. / upsmov, scdadv, upsdrv, cour5q, zonfci
hydro	Controls the advancement of the hydrodynamic calculation. / snapit, stcset, stcset, valve, volvel, tfront, phantvd, phantv, phantjd, phantj, fwdrag, hloss, vexplt, jchoke, ccfl, jprop, vfinl, eqfinl, mover, vimplt, pimplt, mover, jprop, simplt, brntrn, state, level, jprop, vlvela, nanscj, nanscj, nanscv, nanscv, nanscv, nanscv, nanscv, nanscv, htfinl, scfinl, helphd
rkin	Advances space independent reactor kinetics. / polat
scdpsh	Controls the advancement of SCDAP after the call to hydro. / scdfnl, tcoupl, trupt
convar	Advance control variables over a time step. / polat

3. Conclusions

The analyzed results of two codes are introduced for the severe accident code development along with their functions. The above results and established documents can be used by code developers, and present more useful information for code users. A more detailed analysis for the two codes will be developed in the future.

REFERENCES

[1] D.H. Kim, et.al., “Analysis of MELCOR structure”, KAERI/TR-1543/2000 (in Korean), Daejeon, 2000.
[2] S.D. Kim, et.al., “Review of the SCDAP/RELAP5/MOD3.1 code structure and core T/H model before core damage”, KAERI/TR-1037/98 (in Korean), Daejeon, 1998.