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Dr. George L. Mesina

Remote RELAP5-3D Information

Outline Remote RELAP5-3D

- Background
- Advantages and Disadvantage
- Project Description
- Using Remote RELAP5-3D
- Future Developments

RELAP5-3D Description

Starting in 1966, Idaho National Laboratory developed a series of RELAP computer programs for analyzing transients and accidents in water-cooled nuclear power plants and related systems as well as the analysis of advanced reactor designs.

- Series RELAPSE, RELAP2, RELAP3, RELAP4, RELAP5
- Ongoing: RELAP5-3D
- 3D fluid flow and neutronics, multi-dimensional heat conduction
- Many applications
 - Model many reactor types: PWR, BWR, HWR, MSR, LMR, GCR, SMR, micro
 - Analyze operational transients and accident scenarios
 - Aid plant design, operator training simulators, etc.

Reason for Remote RELAP5-3D

- Previously distributed code via CD-ROM and DVD with separate distribution of license file.
- U. S. Department of Energy (DOE) established new rules for DOE-developed nuclear codes and DOE-asserted nuclear codes
 - RELAP5-3D is a DOE 10 CFR Part 810 asserted code and therefore has additional security reviews
 - Distribution of source and executable versions of nuclear codes shall be managed to protect them from inappropriate distribution and use.

Gaining access to Remote RELAP5-3D

1. Remote RELAP5-3D is accessed via the INL High Performance Computing (HPC) platform .
 - a. This requires an INL HPC account.
2. Request an HPC account on the INL Nuclear Computational Resource Center (NCRC) website:
 - a. <https://inl.gov/ncrc/>
 - b. When the HPC account is approved, NCRC sends requestor an email with the subject “Account Creation.”
3. After receiving the account creation email, logon to the NCRC account and request access to Remote RELAP5-3D.
4. NOTE: Your organization must have an active RELAP5-3D license for you to receive access to Remote RELAP5-3D.

Access Change with Remote RELAP5-3D

- For approved users, the primary method of access will be execution of the software remotely on a DOE or national laboratory system
- Any additional access will be considered on a case-by-case basis based on the technical justification and need
- The INL HPC is a protected environment that allows users to access only specific directories
 - The HPC has procedures in place to allow access to DOE asserted nuclear codes and has high security measures in place

Creation of Remote RELAP5-3D

- Working group convened virtually
 - Many questions were studied, discussed, and answered
 - DOE requirements had to be satisfied
 - Many user needs anticipated and means found to satisfy them.
- RELAP5-3D team created an executable from version 4.4.2
 - Most recently released code version is 4.4.2
 - Built with same compiler level as original release
 - Standard installation, verification, and developmental assessment cases run
 - Verification and validation performed and reported.

Creation of Remote RELAP5-3D

- Code moved into MOOSE herd of INL's HPC
 - Protected so it is not able to be copied.
- RELAP5-3D team retested it in its new location with its new protection
 - It cannot be copied or linked to
 - Standard installation, verification, and validation (Developmental Assessment) cases run.

Advantages of Remote RELAP5-3D

- Each user receives their own completely secure and separate work area
 - Separate disk space in INL's HPC disk farm
 - Can upload and download files to it from user's machine
- Faster runtimes and bigger storage
 - INL has some of the fastest supercomputers in the world, so code will generally run faster on them than on a local computer
 - INL brings in a newer faster supercomputer periodically (annually)
 - Typical disk allotment allows storage of many output files
 - Detailed parameter studies of large models possible.

Advantages of Remote RELAP5-3D

- Most recently released version of RELAP5-3D is always available
 - Stay at the cutting edge
 - Current version 4.4.2, Version 4.5.1 to be released in a few months
 - Some older versions may be maintained
 - Policy not finalized.
- No more license files
 - License file had to be located properly in file structure to work
 - Presence of expired license files could prevent code from working
 - HPC prevents Remote RELAP5-3D access when license expires.

Advantages of Remote RELAP5-3D

- Access to RELAP5-3D peripherals in one place, no need to obtain them separately
 - Aptplot – Interactive program to display RELAP5-3D plot files
 - Aptbatch – Batch program to display RELAP5-3D plot files
 - r2dmx – Program that demultiplexes a RELAP5 restart file
 - PyPost - Python Postprocessor for analysis of code results and experimental data
 - Pygmalion – Program that moves output from a steady-state run into a new input file
 - SNAP* - Symbolic Nuclear Analysis Package
 - * only available to registered SNAP users.
 - <https://www.snaphome.com/WebPages/Register.jsp>

Advantages of Remote RELAP5-3D

- Access to RELAP5-3D related programs and data
 - Fluid property library
 - RAVEN
 - R5exec (not yet available).
- Access to INL's HPC utility software.
 - Examples include version control, compilers, math programs

Advantage and Disadvantage of Remote RELAP5-3D

- Runs in INL's HPC environment
 - Linux only
 - Remote RELAP5-3D does not support Windows operating systems
- Majority of IRUG will receive no new code distributions
 - Local copies of RELAP5-3D will cease to work when current license expires.

Using Remote RELAP5-3D

- Runs in INL's HPC environment
 - Must load proper modules to have access to codes
 - Must access the codes from their proper paths
 - The information to access RELAP5-3D is as follows:

RELAP5-3D	PATH	MODULES
Remote RELAP5-3D Executable	/apps/herd/relap5/relap5	use.moose Moose-apps RELAP5
Remote RELAP5-3D fluids files	/apps/herd/relap5_fluids	use.moose

- Loading all three creates a shortcut for running RELAP5-3D (next slide)
 - Linux command: `module load use.moose moose-apps RELAP5`

Using Remote RELAP5-3D

- To run Remote RELAP5-3D type (at the command line prompt):
`/apps/herd/relap5/relap5 -i inputfile -o outputfile -r restartfile`
`/apps/herd/relap5/relap5 --help` (Lists 50+ command line options)
- If you load the modules (previous slide), this command will work
`relap5 -i inputfile -o outputfile -r restartfile`
- To plot a Remote RELAP5-3D plotfile
`/apps/local/AptPlot/bin/aptplot.sh`

Using Remote RELAP5-3D

- To access RELAP5-3D peripherals:
 - Must load proper modules and access proper paths

Auxiliaries	PATH	MODULES
AptPlot Batch access	/apps/local/AptPlot/bin/aptbatch.sh	AptPlot
AptPlot GUI access	/apps/local/AptPlot/bin/aptplot.sh	AptPlot
RELAP5 to demux format	/apps/local/AptPlot/bin/r2dmx.sh	AptPlot
Manuals for auxiliaries	/apps/local/AptPlot/bin/manuals/	AptPlot
SNAP GUI access	/apps/restricted/SNAP/3.1.5/bin/model_editor.sh	use.restricted

- Linux command: `module load AptPlot`

Future Developments of Remote RELAP5-3D

- Future code version releases immediately available
- Scripts for running Remote RELAP5-3D and peripherals more conveniently
- Additional RELAP5-3D related software
 - Polate – quick and easy fluid property calculator
 - R5exec – Couple Remote RELAP5-3D with other codes
- POSSIBLE native coupling with MOOSE.

Summary

- DOE made changes to the availability of nuclear computer programs
- INL complied with these changes to produce Remote RELAP5-3D
- Remote RELAP5-3D version 4.4.2 is the most current version
- Users have their own separate secure work areas
- Remote RELAP5-3D runs on a Linux O/S
 - Windows O/S is no longer supported
- There are many advantages to users including speed, storage, most recent version, access to peripherals, etc.