

Online Advanced GOTHIC Training

Numerical Advisory Solutions is pleased to offer online GOTHIC training options using the Microsoft Teams platform. The online classes cover specific topics of interest to the GOTHIC user community in a shorter format than our standard multi-day training courses. These specialized classes are intended for individuals that have already completed the introductory training class or are already proficient working with GOTHIC.

Class Details

- Each class will begin at 10 AM ET and consist of instructor led presentation, including theory, guided example(s), and time for Q&A, followed by a hands-on exercise.
 - Approximate lengths of the instructor led presentation for each class are listed on the Course Descriptions.
 - The maximum class length per day is 4 hours. Exact class hours may vary.
 - An appointment with a link to join the class through Microsoft Teams will be provided at least 1 week prior to the scheduled class.
- Participants can either stay online while completing the exercise or complete it on their own time after the class.
 - The instructor will remain online after the class to answer questions for anyone that chooses to remain online.
 - Alternatively, participants will have access to the instructor via email, telephone, or a 1-on-1 session through Microsoft Teams for up to 1 week after the class to ask questions or check the results of the exercise.
- Due to the hands-on nature of the class, it is required that each student participating be individually connected to the Teams session to allow for interaction and screen sharing as needed for questions.
- All classes will be conducted using GOTHIC 8.4. Participants must have the software installed and activated prior to the class.
- Access to GOTHIC should be available on the same computer used to access Teams to allow the student to share their screen should issues arise. Also, access to an email application is important because the student will be required to send models developed during exercises to the instructor(s) for review and receive feedback during the course.
- Participants will also be given access to an electronic copy of the course materials that can be downloaded from a secure file transfer site.
- Each class may consist of one or more of the topics detailed below. Course titles on the website will detail the topics to be covered in the class.

3D Modeling

2.5 hour class with hands-on exercise

Introduction to 3D modeling concepts in GOTHIC. Specific topics covered are volume and cell face porosity, volume and cell hydraulic diameters, 3D connectors, spanned thermal conductors, cell inspector, and solution options. A hands-on exercise is provided applying 3D modeling techniques of porosity, 3D connectors, and spanned thermal conductors.

Advanced Thermal Conductor Training

3.0 hour class with hands-on exercise

Advanced conductor modeling topics are covered including different conductor spanning techniques, spatial heat load modeling, conductor initialization, fluid temperature control using a conductor, ice modeling, and 2D conductors. A hands-on exercise is included to model a pump within a facility challenged by freezing conditions.

Basics of Modeling Fluid Hammer

8 hour class with hands-on exercise

Note: This class is held over 2 days, 4 hours per day.

Various systems in existing and advanced reactor designs are vulnerable to fluid hammer and related hydraulic transients, and it important to design and operate them such that these transients are prevented or at least mitigated. For this reason, this phenomenon has attracted industry and regulatory attention (e.g. IN-98-31, GL-96-06, GL-08-01, NSAL-09-08). Furthermore, rapid valve closure, such as that associated with turbine stop valves, can also produce hydraulic transients that can challenge piping pressure boundaries and supports. Areas to be examined include fluid-hammer thermal-hydraulics, along with the Joukowski equation that calculates the upper bound peak pressure for the conditions. GOTHIC modeling includes identification of peak pressure conditions and pipe load calculation. A hands-on exercise is provided for building a model to evaluate fluid hammer.

Constitutive Relations and Physical Models

3 hour class with hands-on exercise

Provides insights into the constitutive relations and physical models in GOTHIC, including the conservation equations, fluid property relationships, flow regimes and limits, interface area in lumped and subdivided volumes, interphase drag, interface heat and mass transfer, drop field behavior, and boiling and condensation heat transfer. Hands-on exercises are included to investigate the response to tables versus equation-based critical flow models and inclusion / exclusion of the mist model.

Drops and Spray Modeling

1.5 hour class with hands-on exercise

Discussion of drop fields and aerosol mechanics modeling in GOTHIC along with usage of the spray nozzle. Topics include multiple drop fields, input specification, drop field interactions (agglomeration and deposition mechanism), methods for introduction and removal of drops, spray nozzles cone angle and oblique flow paths, momentum transport improvements, and orthogonal momentum transport. A hands-on exercise is provided using cone angles, oblique flow paths, and multiple drop fields.

Fission Product Modeling

2.5 hour class with hands-on exercise

An examination of GOTHIC's tracer capability and how to apply it for tracking constituents in your models for a variety of applications. Topics include how to define tracers and tracer sets, a review of the tracer balance equation, tracer sources, important components such as generalized filters, charcoal filters and dryers/demisters, and output options. Hands on exercises will be included to reinforce these concepts and provide experience on how to setup and apply tracers in practice.

Flooding Analysis Using GOTHIC

8 hour class with hands-on exercise

Note: This class is held over 2 days, 4 hours per day.

A presentation on considerations for modeling internal and external flooding in GOTHIC. This will include modeling strategies (1D, 2D and 3D), flooding sources and rates, modeling of flood potential propagation paths (including door gaps and drains), equipment to model (such as doors, ventilation, gratings, drain check valves), and equipment failures caused by flooding. A hands-on exercise is provided to simulate internal flooding of a multi-level building using a simplified GOTHIC model that includes a limited amount of flood prevention equipment. A hand-on exercise is provided to investigate external flooding mitigation.

GOTHIC Command Files and Scripting

2 hour class with hands-on exercise

Methods to automate GOTHIC operations using scripts, including recording and playing back GOTHIC command files (GCF), scripting command files, tools, and their benefits. A hands-on exercise is provided to generate, edit and use GOTHIC command files and batch files to run GOTHIC from the command line for automating a series of GOTHIC simulations.

GOTHIC Data Visualization with ParaView

8 hour class with hands-on exercise

Note: This class is held over 2 days, 4 hours per day.

Participants must have ParaView v5.8.0 (or later) installed on their computer prior to the start of training - <https://www.paraview.org/download/>

GOTHIC Scenario Manager

2 hour class with hands-on exercise

Exploration of GOTHIC's Scenario Manager for use with permutation studies and case analysis. Discussion of operation methods and advanced uses for full model manipulation from a base model including multi-case post processing. A hands-on exercise is provided to configure multiple scenarios, run cases, and compare results. Python installation is required.

Intrinsic Losses in Subdivided Modeling

4 hour class with hands-on exercise

Exploration of intrinsic pressure losses within and between GOTHIC subdivided and lumped control volumes. Included topics are irreversible and reversible pressure losses, pressure losses in analyses, intrinsic loss

in subdivided modeling an obstruction, orifice, elbows, or abrupt area change, and momentum transport. A hands-on exercise is included to evaluate intrinsic losses in a subdivided model.

Modeling Break Flow

4 hour class with hands-on exercise

Provides insight to the important, but nuanced, critical flow phenomenon, highlights technical & licensing considerations for break flow modeling, and summarizes similarities and differences in the RELAP5 and GOTHIC technical approaches. A hands-on exercise is included to gain experience with critical flow modeling by performing some simple sensitivity analyses.

Modeling Gas Entrainment

8 hour class with hands-on exercise

Note: This class is held over 2 days, 4 hours per day.

Gas voids in piping upstream of pumps can be entrained and drawn into pump suctions, resulting in degraded pump performance, loss of NPSH, cavitation or even gas binding, all of which can impair the mitigation of nuclear plant accidents. For this reason, this phenomenon has attracted industry and regulatory attention (e.g., SER 2-05, GL-08-01, NEI 09-01). Because of this issue, it is necessary to verify that gas accumulation from active gas intrusion mechanism remains less than the volume that challenges the ability of a system to perform its design function. Such void size limits are determined by means of hand calculations and computer codes such as GOTHIC. GOTHIC modeling includes identification of pump suction void fraction profiles. A hands-on exercise is provided for building a model to evaluate gas entrainment.

Modeling Gas Water Hammer

8 hour class with hands-on exercise

Note: This class is held over 2 days, 4 hours per day.

If there are gas voids in piping downstream of pumps, pump start can result in water hammer transients challenging piping pressure boundaries and supports, both of which can impair the mitigation of nuclear plant accidents. For this reason, this phenomenon has attracted industry and regulatory attention (e.g., GL-08-01, NEI 09-01). Because of this issue, it is necessary to verify that gas accumulation from active gas intrusion mechanism remains less than the volume that challenges the ability of a system to perform its design function. Such void size limits are determined by means of hand calculations and computer codes such as GOTHIC. GOTHIC modeling includes identification of peak pressure conditions and pipe load calculation. A hands-on exercise is provided for building a model to evaluate gas water hammer.

Modeling Heat Exchangers

2.5 hour class with hands-on exercise

Modeling fan coolers and water/water heat exchangers in GOTHIC, including assumptions and limitations, heat exchanger configurations, secondary-side options, and assessing the performance of fan coolers and water/water heat exchangers. A hands-on exercise is provided for building a fan cooler type heat exchanger using data from a specification sheet.

Modeling Nuclear Fuel

2.5 hour class with hands-on exercise

Important aspects of modeling nuclear fuel are addressed including an example of how to use local control variables for modeling axial power shapes and radial peaking in the fuel conductors. Included are

discussions of fuel & cladding material properties, extracting useful information about the fuel, nuclear heat sources, straight decay heat without kinetics, and point kinetics models. A hands-on exercise is included to model simple, multi-zone core.

Modeling Pipes and Ducts

6 hour class with hands-on exercise

Note: This class is held over 2 days, for a maximum of 4 hours per day.

Aspects of using each of three GOTHIC modeling elements to represent pipes and ducts: 1) Networks, 2) Lumped Volumes and Flow Paths, and 3) Subdivided Volumes. Advantages and disadvantages of each approach are discussed along with modeling guidance and best practices. Use of loss coefficients and critical flow models are presented along with the importance of static versus stagnation pressure. Included are considerations for series and parallel of pipes/ducts of different sizes. A hands-on exercise is included to demonstrate pipe modelling concepts.

Modeling Pumps and Fans

2 hour class with hands-on exercise

Modeling of pumps and fans in GOTHIC is presented. Training covers the different built-in pump and fan models (e.g., homologous pump curves) and provides guidance on developing model input (e.g., homologous head curves). Training also covers other optional input (e.g., pump / fan efficiency) and provides guidance on loop modeling and static vs. stagnation pressure effects. A hand-on exercise is provided for pump modeling considering different modeling scenarios.

Net Positive Suction Head

2.5 hour class with hands-on exercise

Prevention of cavitation damage caused by inadequate net positive suction head (NPSH) is critical to safe plant operations, ensuring short and long-term operation of safety-related pumps at required flowrates. Available and required NPSH are discussed along with regulator guidance and calculation requirements. Effects of entrained air/gas and pump suction and discharge recirculation phenomena are evaluated. The GOTHIC NPSH Output calculation is presented as a potential calculation method for use with existing or new plant and system models.

Room Heatup Analysis

4 hour class with hands-on exercise

An overview is provided of the best-practices for GOTHIC room and building heatup analyses with guidelines for the important phenomena, noding detail, flow connections, thermal connections, model initialization, connections to the atmosphere, heat sinks, heat loads, doors, ventilation system, heat exchangers, and model verification. A hands-on exercise is included to demonstrate the complexities of modeling a room heatup analysis.

Spent Fuel Pool Modeling

2.5 hour class with hands-on exercise

A presentation on considerations for spent fuel pool modeling in GOTHIC, including modeling strategies, nodalization, and loss of cooling simulation. A hands-on exercise is provided for building a simplified GOTHIC model of a spent fuel pool using nested subdivided control volumes and 3D connectors.

Surface-to-Surface Radiation

2 hour class with hands-on exercise

Discussion of modeling the surface-to-surface thermal radiation model in GOTHIC, including assumptions, adding thermal radiation to a model, and calculation and application of shape (view) factors. A hands-on exercise is provided for determining shape factors and applying of thermal radiation in a GOTHIC model.

Please periodically check back for more course offerings....