PROTO-FLO™
Windows

ZACHRY

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## OUR OTHER SOFTWARE PRODUCTS!

PROTO-HX™ Air Coil

PROTO-HVAC™ Windows

PROTO-Sprinkler™

PROTO-HX™ Shell & Tube

DESIGNED BY ENGINERS FOR ENGINEERS

There exists a need within the power industry to perform multiple evaluations of plant hydraulic systmes for a variety of alignments that consider flow path variations, heat exchanger heat loads, pump combinations, etc. To meet this need, Zachry has developed advanced modeling software to perform such evaluations expediently, efficiently and consistently. This software is used by Zachry and utility personnel, alike. It is user friendly, has sufficient flexibility to meet anticipated modeling needs, and was developed in accordance with a nuclear grade quality assurance program.
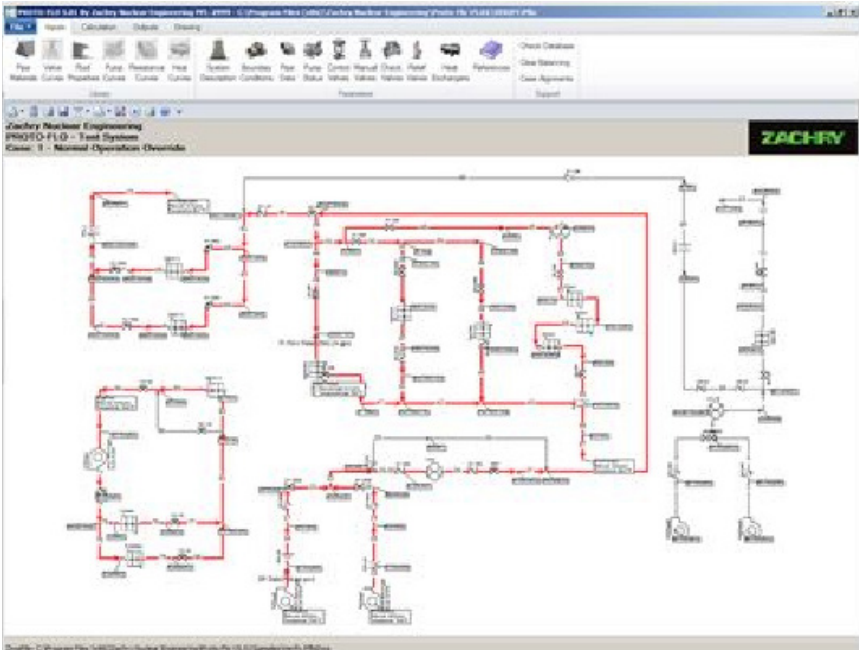
WHAT'S POSSIBLE WITH PROTO-FLO

Here is a list of just some of the things that can be analyzed using PROTO-FLO:

- Design Basis Performance Analysis
- Operability Evaluations
- Stress Data Package Input Analysis
- Stretch and Extended Power Uprate Analysis
- Ultimate Heat Sink temperature and elevation change evaluations
- Model Benchmarking/Tuning to Test Data
- Establish System Test Flow Criteria
- Pump Sizing
- Strong Pump Weak Pump Interactions
- Impacts of Diesel Droop
- Pump Run-out Evaluations
- Determine Minimum Pump Curves
- NPSH Analysis
- Vertical Pump Submersion and Vortexing Evaluations
- Minimum Required Flow Analysis

- Component Pressure Drop Surveillance Limits
- Component replacement evaluation
- Pipe Velocity Calculations
- Orifice Sizing
- Investigate Choked Flow
- Vacuum Breaker Evaluations
- Seismic break impact analysis – impact on the system and building flooding rates
- Tube Rupture Flow Rate Analysis
- Control Valve Position Evaluations
- Multiple Spurious Operation Analysis
- AFW Cavitating Venturi Analysis
- Maximum Allowable CCW System Temperatures
- Heat Exchanger Thermal Performance
- Heat Exchanger Macrofouling System Impacts
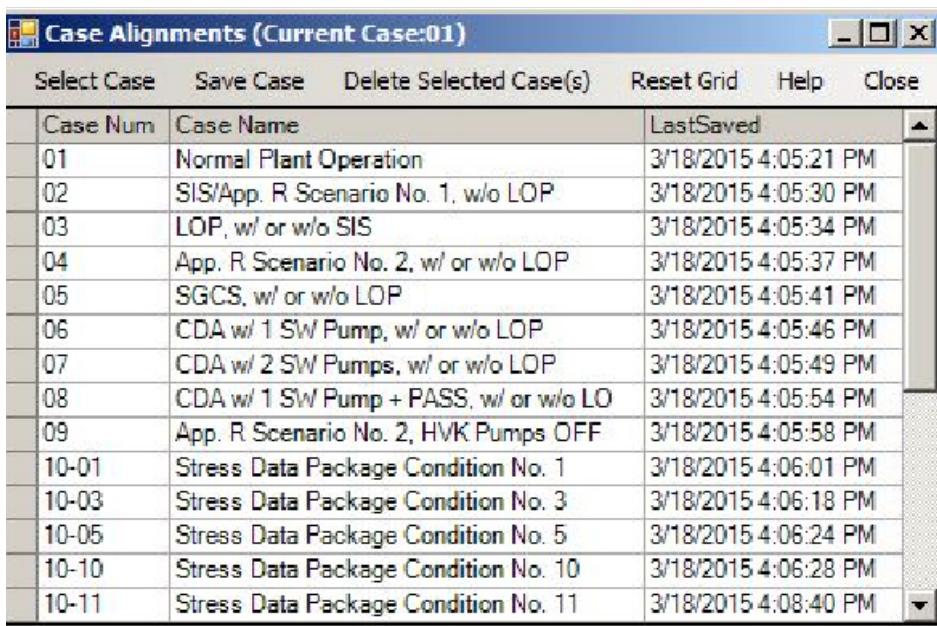
FEATURES FOR THE NUCLEAR INDUSTRY

- **Nuclear Quality Assurance** (10CFR50 and 10CFR21) **Validation Program and Error Reporting** allowing you to use PROTO-FLO for you safety related calculations immediately.

- **"What If"** — When system conditions change, for any reason, the engineer needs to know precisely what to expect. PROTO-FLO removes the uncertainty factor by showing cause and effect relationships. Whether it is a new design, contemplated upgrade, normal degraded performance over time, or catastrophic component failure, the software will provide a detailed analysis.

- **Operability** of abnor mal system alignments can be evaluated and documented to justify continued operations.

- **Accident Analyses** are possible to determine significant results which may be adverse to the system.

- **On-line Help** that makes it easy to find the information you need.

- **Comprehensive Technical Support** from both power plant system engineers and computer specialists who are very familiar with design and regulatory issues.

- **Default Differences Reports** quickly and easily identify the system alignment being analyzed and the default reference mode of operation.

- **Library of standard data** that can be supplemented with user-defined data.

- **Engineering Analysis Services** to support model development, conversion, and use.

MODEL ALL MODES OF OPERATION WITH CASE ALIGNMENTS

Just as systems are operated in various alignments, a PROTO-FLO model can contain multiple alignments, or cases. Changing your model from Normal Operation to an accident alignment to a what if scenario is as easy as selecting a case. PROTO-FLO makes it easy to select and save your case related parameters.

Case Alignments (Current Case:01)   _ □ ×

| Select Case | Save Case | Delete Selected Case(s) | Reset Grid | Help | Close |

Case Num	Case Name	LastSaved
01	Normal Plant Operation	3/18/2015 4:05:21 PM
02	SIS/App. R Scenario No. 1, w/o LOP	3/18/2015 4:05:30 PM
03	LOP, w/ or w/o SIS	3/18/2015 4:05:34 PM
04	App. R Scenario No. 2, w/ or w/o LOP	3/18/2015 4:05:37 PM
05	SGCS, w/ or w/o LOP	3/18/2015 4:05:41 PM
06	CDA w/ 1 SW Pump, w/ or w/o LOP	3/18/2015 4:05:46 PM
07	CDA w/ 2 SW Pumps, w/ or w/o LOP	3/18/2015 4:05:49 PM
08	CDA w/ 1 SW Pump + PASS, w/ or w/o LO	3/18/2015 4:05:54 PM
09	App. R Scenario No. 2, HVK Pumps OFF	3/18/2015 4:05:58 PM
10-01	Stress Data Package Condition No. 1	3/18/2015 4:06:01 PM
10-03	Stress Data Package Condition No. 3	3/18/2015 4:06:18 PM
10-05	Stress Data Package Condition No. 5	3/18/2015 4:06:24 PM
10-10	Stress Data Package Condition No. 10	3/18/2015 4:06:28 PM
10-11	Stress Data Package Condition No. 11	3/18/2015 4:08:40 PM

In each case, you can define specific boundary conditions, pump status, heat exchanger heat loads, valve positions, control valve settings, relief valve conditions and many other parameters.
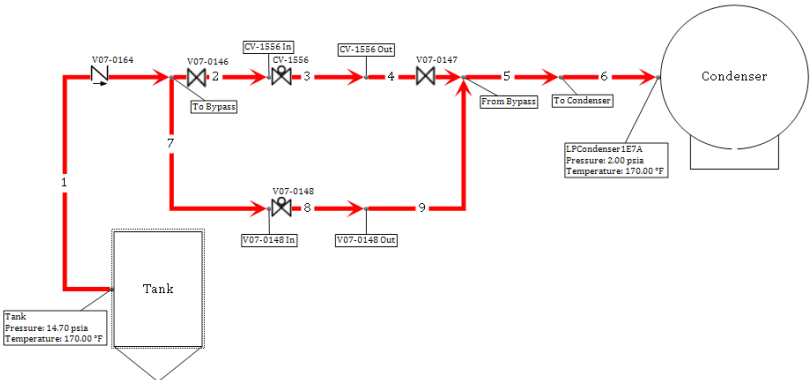
CASE 1
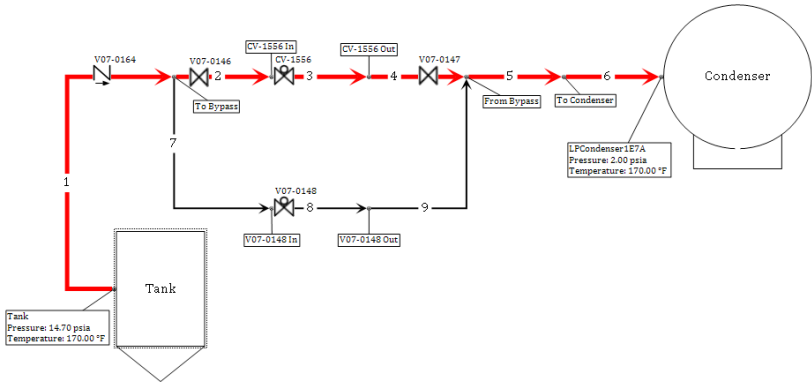
CASE 2
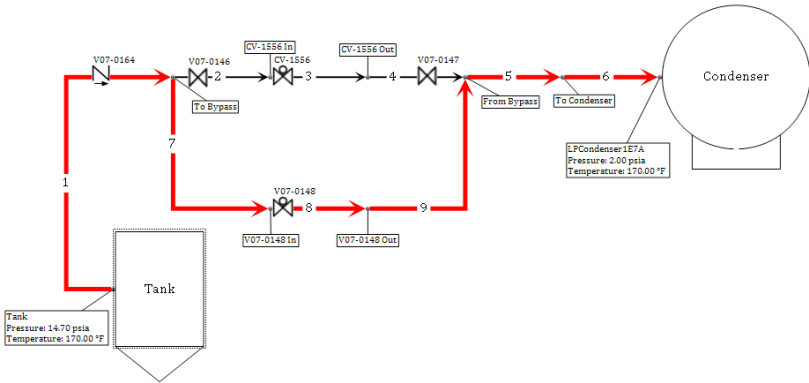
CASE 3

SYSTEM COMPONENTS

PUMPS

In a real system a pump will operate along its associated curve providing a discharge flow for a specific total developed head. However, the user might want to consider different pump curves for any given analysis. For a minimum flow analysis, the user might want to consider a degraded pump curve. For an NPSH analysis, the design pump curve would be more appropriate. PROTO-FLO allows the user to pick from a family of pump curves for any pump used in a particular PROTO-FLO Case Alignment
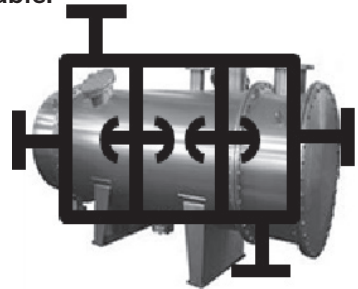

- TDH vs Flow
- NPSHR vs Flow
- Efficiency vs Flow
- Easy to create
- Modified curves
- Change pump performance by changing pump speed
- Warnings when pump operates beyond end of curve and when NPSH required is less than NPSH available.
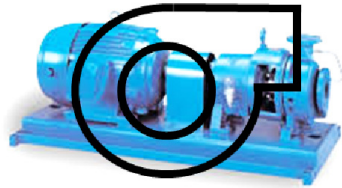
HEAT EXCHANGERS
Heat Exchanger Types

- Fixed Head Load
- UA
- Shell & Tube
- Heat Map
- Link to your PROTO-HX Model

Analyzing the addition or removal of heat in PROTO-FLO can be as simple as using a Fixed Heat Load type heat exchanger or as detailed as using a Shell and Tube type heat exchanger. Additionally, there is the capability to link to your PROTO-HX models.

VALVES

If you want to isolate flow or control parameters in a system, you use a valve. Just like in a real system, you do the same thing with PRO-TO-FLO.

Features to make your modeling easier

- **Library of Valve Curves**
- **Generic CV Calculator**
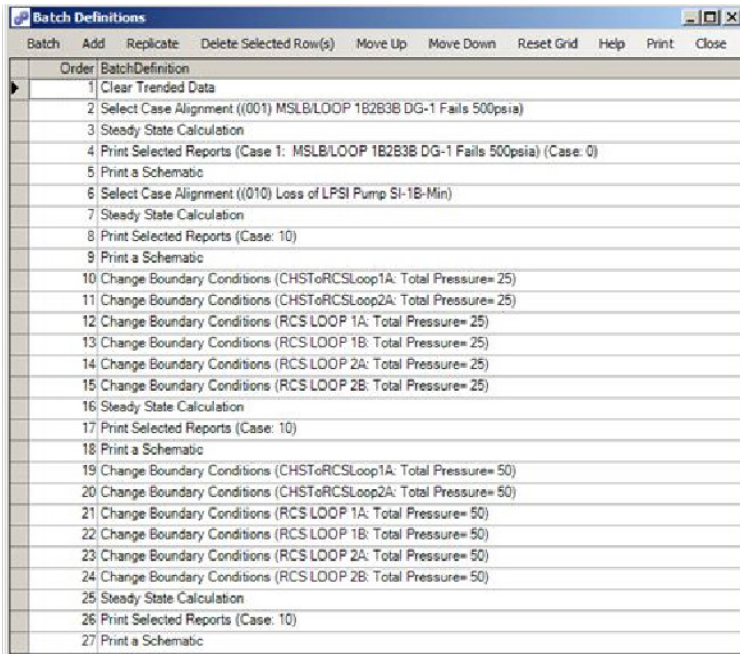- **Checks for Cavitation**
- **Valve Throttling**
- **Travel Stops**

Control Valve Types

- **Manual Valves**
- **Control Valves**
- **Relief Valves**
  - *Flow*
  - *Pressure*
  - *Temperature*

STREAMLINE CALCULATIONS WITH BATCH PROCESSING

A design engineer must analyze a variety of system alignments. Making a change to a system component could require that all the cases in a model be rerun. Where before you would run a case, print reports, run the next case, etc., now all you need to do is run a single batch to do the work for you.

Beyond changing and running cases, you can also change parameters with batch processing. For example, if you wanted to run an AFW model case for a range of steam generator pressures, you could create a batch definition to change the pressures and run the cases.

REPORTS AND GRAPHS

With so many reports available, it is easy to document all of your inputs and outputs. In fact, sometimes a calculation requires little more than a brief explanation of the attached reports.

User Defined Reports

If you still can't find the report you need, PROTO-FLO allows you to make your own "User Defined" reports.

Default Differences Report

This is one of the most effective tools for streamlining verification that there is. This report identifies differences between cases, either in separate models, or two cases in the same model. Once one case is verified, the reviewer can use this report to ensure that the correct changes have been implemented.

Formatted Reports

- Calculation Summary Report
- Flow Summary Report
- Node Summary Report
- Combined Output Report
- Hydraulic Resistance Report
- Boundary Condition Report
- Pipe Section Summary Report
- Pump Status Report
- Pump Curve Data Report
- Control Valve Line-Up Report
- Manual Valve Line-Up Report
- Valve Data Report
- Valve Curve Data Report
- Variable Resistance Data Report
- Relief Valve Data Report
- Heat Exchanger Data Report
- Heat Map Data Report
- Fluid Properties Report
- Balancing Parameters Report
- Instrumentation Data Report
- Differences Report
- Trended Data Report
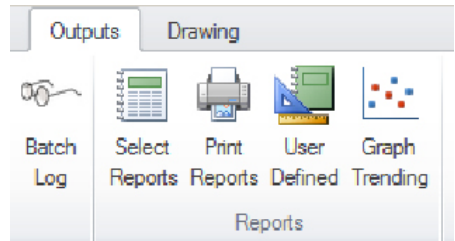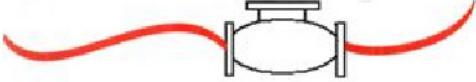
SCHEMATIC INTERFACE

Creating a schematic drawing has never been easier. With just one click, an entire schematic will be generated from your database. Once drawn, it is easy to reconfigure the drawing to give it the look you want.
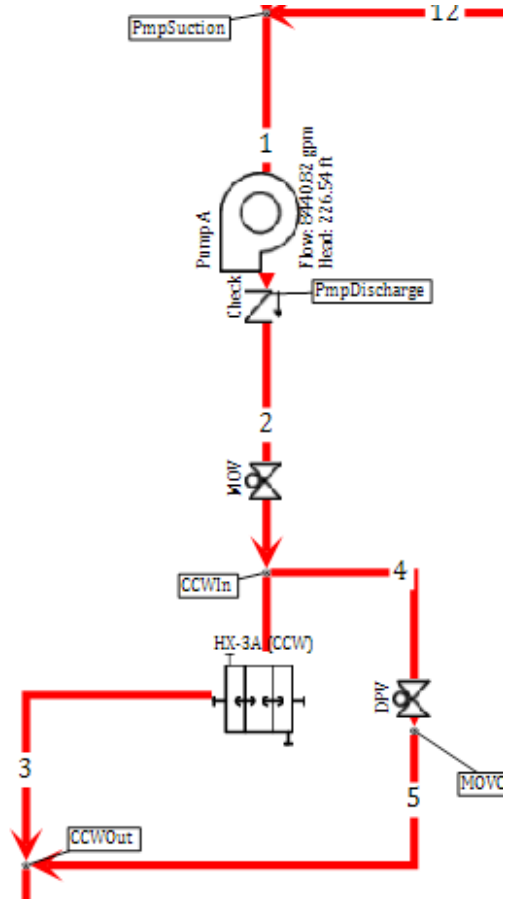
Our software was developed and tested for use in the design, analysis, operation, modification, repair and maintenance of structures, systems and components of nuclear facilities, in accordance with ASME-NQA 1, subpart 2.7. As such Zachry Nuclear Engineering, Inc. does extensive validation and verification of the software to ensure its accuracy.

NEW IN VERSION 5

- A new user interface makes building and navigating models even easier

- A Batch Processing capability allows you to automatically change cases, change input parameters, run the calculations, save reports and update drawings all in one step.

- A new flow based solver has been added to the original pressure based solver.

- PROTO-FLO can now generate a schematic automatically from an existing database.

- A graphing capability has been added for trending data.

- You can now save which reports are printed, header and footer information, and default database selection from the Report Selection Window. Additionally, the user can specify that reports are sent to the screen, printer and/or file all in one selection.

- A References Table has been added to support model calculation preparation.

- Use your Proto-HX V5 files of Shell & Tube, Air Coil, or Plate Frame heat exchangers can be used directly by PROTO-FLO

- Case Numbers are now alpha numeric

- A Void Resistance Fitting has been added so PROTO-FLO can calculate a resistance if a pipe has an upstream node with pressure below vapor pressure.

- Vacuum Breakers have been added to allow modeling of resistance due to air entering the system

- There is a new Pipe Fittings Table in the Pipe Data Window. The description field in this table can be used to document the length of a pipe.

- You can import multiple Valve Curves, Pump Curves, Resistance Curves, and Heat Curves from the PROTO-FLO input windows.

- There is a new junction methodology (Oka-Ito) in addition to the original (Idelchik) method.

- NPSH Curves can now vary with pump speed.

- Variable Resistance Curves are now case related.

- Control valve recovery coefficients can vary with valve position.

WE ARE THERE WHEN YOU NEED US.

QUESTIONS? CONTACT US
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(860) 446–9725

BENEFITS OF AN ANNUAL SOFTWARE MAINTENANCE AGREEMENT

Error notification as required by ASME-NQA-1, Subpart 2.7 for nuclear safety related software.

Technical support on an as-needed basis.
Our experience with the software, through development and daily use, gives us the best experience for modeling a system or component, specifying inputs, and benchmarking models, which gives you the most out of your analyses.

Assistance in installing your software.
This includes installation of any upgrades and, if you are in the process of upgrading your computer network, reinstalling the software. This will minimize downtime.

Maintenance revisions to the software are sent at no additional cost to all registered owners with current maintenance contracts.

ZACHRY

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