PGESCo Engineering Magazine

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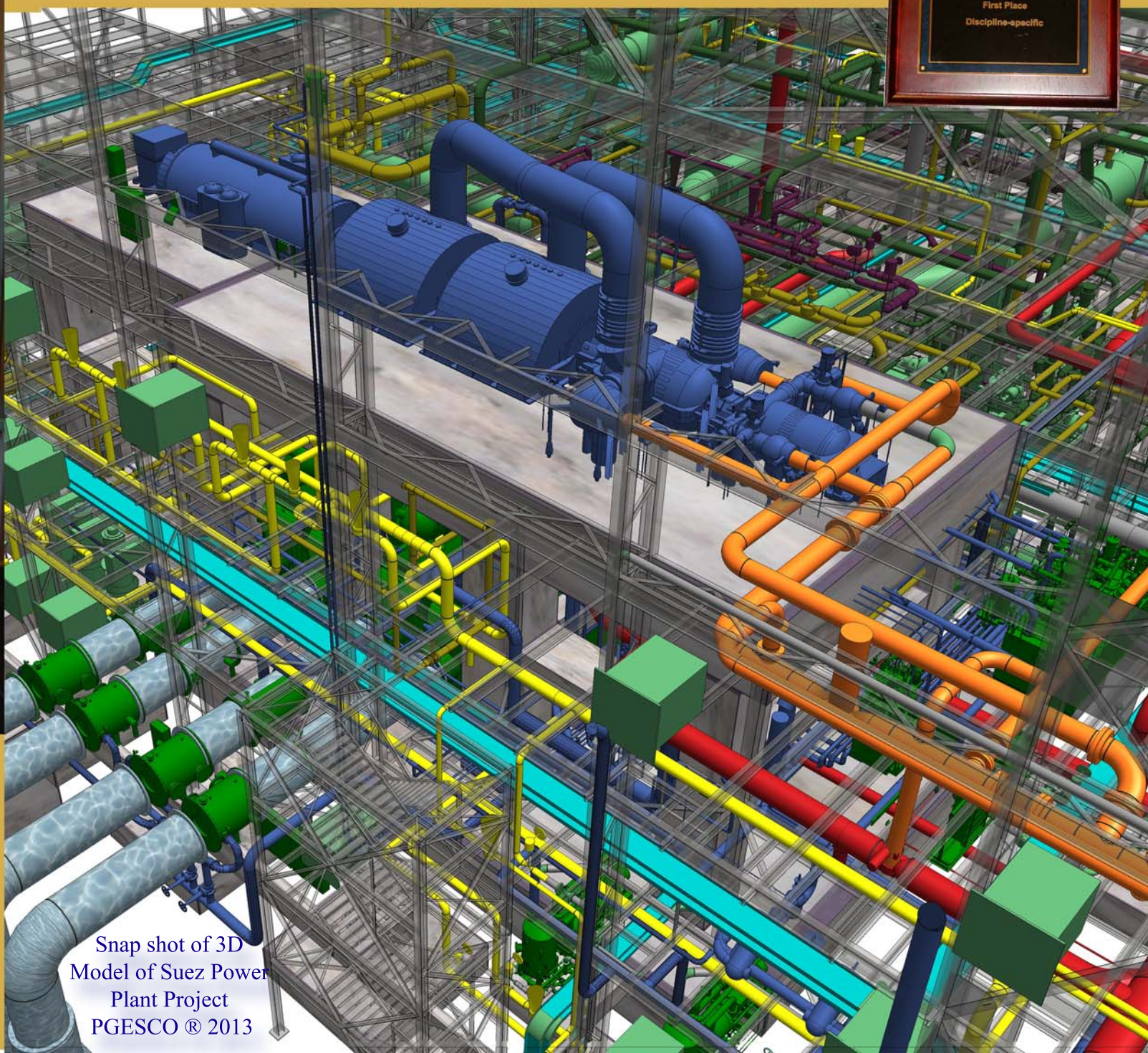
VI
July, 2013

in this issue ....



Snap shot of 3D Model of Suez Power Plant Project PGESCO ® 2013

Editor's Note..

By today, it would be more than a year and 6 issues of "PGESCo Engineering Magazine" – or the "Newsletter" as was titled for its first 5 issues. Other than the change in the name, I consider this issue a very special one. In our VI issue we have published three articles presenting excellent engineering activities, and one article administration service; that represent the high quality and superior engineering level of PGESCo management and family of engineers. The first article presents how the SmartPlant Platform software was implemented since early 2010, and achieved great success winning the first prize in Intergraph "Golden Valve Award". The second paper presents how for the first time in PGESCo history an "Operator Training Simulator" is developed and tested in PGESCo office. The third paper presents a new techniques used for the transient analysis of piping system using two commercial programs in a consecutive manner to achieve the required appropriate design for the piping system. In addition, a few words were written to represent the Mail Center, without its excellent work our internal and external mails would be definitely disturbed.
At the end I promise the readers to keep our early intention to improve internal and external communications through the interchange of technical knowledge, news of new technology, research topics, and accomplishment of various PGESCo parties that would encourage and motivate them.

MHB

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On The Cover

The Smart Plant Platform implementation. PGESCo has triumphantly won the 1st place award in the discipline specific category of the "Golden Valve Awards Competition". This competition is conducted annually by Intergraph to recognize the most innovative and well -executed uses of the Smart Plant Enterprise platform

PGESCo First Place Winner at Intergraph Golden Valve Awards

Every year Intergraph Corporation [1], the software vendor responsible for creating the SmartPlant Enterprise Platform, conducts an annual competition known as the Golden Valve Awards Competition [2]. The competition recognizes the most innovative and well-executed uses of the SmartPlant Enterprise platform. It is with great honor and pleasure that we announce PGESCo has won the 1st place prize in the discipline specific category of this competition. PGESCo went head to head with over a dozen companies including engineering giants such as CB&I, Keppel FELS , & Worley Parsons and came out victorious.

INTERGRAPH OVERVIEW

Intergraph Corporation [1] is a leading global provider of engineering software used to visualize complex data. Engineering platforms such as SmartPlant Enterprise allow companies like PGESCo to execute large industrial projects more efficiently and with higher quality and safety. Businesses and governments in more than 60 countries use Intergraph's industry specific software to make intelligent decisions that make processes and infrastructures better, safer, and smarter.

PGESCo MIGRATION TO SMARTPLANT

PGESCo embarked on its mission to migrate to the SmartPlant Enterprise platform in early 2010 as shown in Figure [1]. This was part of a larger vision to control its own licensed technology. Although the task of migrating an entire company to a completely new platform has proven to be challenging, PGESCo engineers have risen to the occasion and surpassed the expectations of many including external companies such as Bechtel and Intergraph itself. Even with a less than ideal geo-political & economic situation in the region, PGESCo has proven itself as an innovator and regional leader in its utilization of technology to achieve its business goals.

Today PGESCo has successfully implemented and is using in production various Intergraph SmartPlant packages. This includes the use of SmartPlant 3D for 3D modeling & physical design, SmartPlant P&ID for P&ID design, and SmartPlant Electrical for electrical design, & SmartPlant Instrumentation for instrumentation and control systems design.

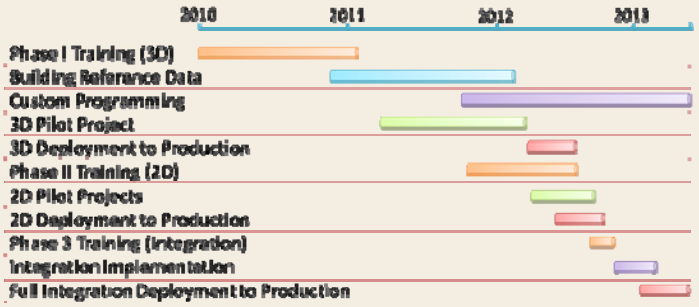


Figure [1]: PGESCo SmartPlant platform timeline overview

PGESCo has also been successful in the initial implementation of the basic integration of these modules. Such integration will give PGESCo the collaborative conduit required to ensure that valid, consistent, and high quality engineering data is shared between applications and engineering disciplines. This will ensure that users will have access to high quality engineering data when and where they need it in order to ensure engineering design is executed with the highest quality and in the most efficient manner possible.

PGESCo has also invested significant time and resources in further developing the SmartPlant Enterprise platform through automation programming and the development of proprietary work processes and catalogs.

PGESCo management has proven that they are committed to achieving a world class implementation of their engineering design technology and have built a CAD technology team that is dedicated to the implementation and deployment of the SmartPlant Enterprise platform. With an enormous amount of collaboration, help, and plain old sweat and hard work, the CAD technology team along with the Engineering management, chief engineers, engineering disciplines, IS&T, and other PGESCo supporting departments have continued to raise the bar and innovate. Moving forward at neck breaking speed, PGESCO is solidifying itself as a regional leader in power engineering design. No challenge is too big for the extremely talented staff at PGESCo who thrive under pressure and continually innovate and revolutionize the way they work to conquer the constantly increasing engineering challenges faced in our region. Currently PGESCo is engaged in the design of 3 major projects using the SmartPlant Enterprise platform. These projects include the Baiji Simple Cycle Power Plant, Suez Thermal Power Plant, & South Helwan Super Critical Power Plant.

Golden Valve Awards Competition

PGESCo proudly submitted entries to three categories of the 2013 Golden Valve Awards Competition. These categories included **Animation** in which we submitted an entry from the Baiji simple cycle power plant, **Visually Complex** for which we submitted an entry from the Suez thermal power plant, and **Discipline Specific** also an entry from the Suez thermal power plant. PGESCo triumphantly succeeded in winning the 1st place prize in the discipline specific category ahead of a submission from a joint venture project done by American Fortune 500 EPCM Flour Corporation and Australian EPCM Sinclair Knight Merz (SKM). China's East China Engineering Science and Technology Co., Ltd. (ECEC) took the 3rd place prize. For list of winners in the Discipline Specific categories see Fig. [2] and for the listing of all winners refer to the 2013 Golden Valve Awards webpage [2]. It is worth noting that this is the first time for a MENA (Middle East and North Africa) country to participate and win the 1st place prize.

Figure [2]:Winners in Discipline-Specific Category. Egypt 1st place.

Preparing the winning entry Figure [3] was a collaborative effort performed by many engineers in an iterative modeling process. SmartPlant3D modeling activities included modeling of engineering commodities such as piping, equipment, valves, electrical cable trays, concrete foundations, steel, hangers & supports, etc. Various vendor model objects were also attached to achieve the final 3D model. All these activities are part of the normal engineering design process carried out by PGESCo for a typical project.

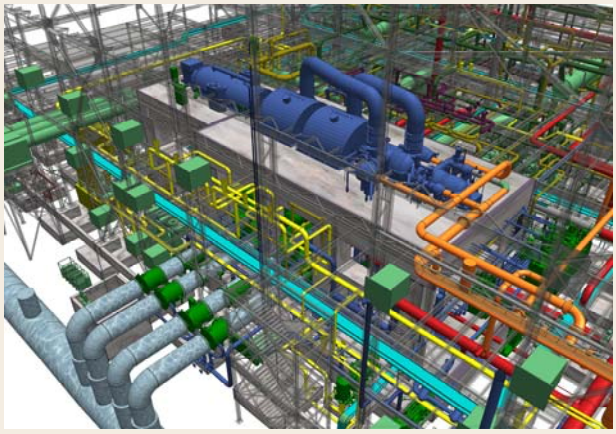


Figure [3]: Winning Entry in the Discipline Specific Category of the Golden Valve Awards Competition. A Snapshot of Suez Power Plant using SmartPlant Review.

Once the 3D model was complete, Intergraph's SmartPlant Review was used to generate the high resolution 3D model files which were then used to create the final competition entry images. Tedious effort was done in SmartPlant Review to create display sets for each group of commodities as well as attaching real image textures to objects such as the circulating water pipes and concrete foundations. Utilization of special SmartPlant Review add-on tools such as the photo realism, ray tracing, and visual effects modules allowed the entry to be enhanced further to produce the final entry images. Once a final set of entry images were created an internal PGESCo committee chose the final images to be submitted to the competition.

Figure [4]: Reward Plaque held by PGESCo General Manger Eng. Sherin Mosbeh.

To commemorate the win Intergraph presented PGESCo with a first place winning plaque (see Fig 4), and a monetary award. In addition the winning image will be included in the 2014 Golden Valve Calendar that is distributed internationally by Intergraph to all companies using Intergraph Process, Power & Marine software giving PGESCo well-deserved international exposure and recognition. Video of all winning entries are also posted on the Intergraph Website and on Youtube [3].

HxGN Live Conference

A team of 6 engineers from PGESCo attended the annual International conference, HxGN LIVE, held by Intergraph to receive the award. Patrick Holcomb executive vice president of business development of Intergraph Process, Power & Marine (PPM) presented the PGESCo team with the award , see in Figure [6].

Moving forward we would like to invite all PGESCo employees to collaborate and get involved in future competitions held by Intergraph and other such organizations. These competitions are great opportunities for PGESCo to showcase our talents and exceptional use of our technology platforms. Furthermore a training plan is being prepared to spread and increase the user knowledge of SmartPlant Review and its special add-on tools to more PGESCo employees so as to enable them to produce high quality animations and images for future competitions and PGESCo marketing material. Coordination with the IS&T department will also result in obtaining higher performance workstations which will enable us to produce even higher resolution renderings of our engineering marvels.

Figure [5]: Winning Entry as appeared on the Golden Valve Booth in HxGN.

In addition, there is a proposed plan for PGESCo to contribute in the “Platinum Pipe Awards Competition” for automation solutions. The CAD Technology team under the leadership of Samer Tageldin has already been engaged in many cutting edge engineering automation solutions to customize the SmartPlant Enterprise experience to deliver even higher efficiency with use of the SmartPlant Enterprise platform.

Figure [6]: Patrick Holcomb delivering the reward to PGESCo engineers

References:

[1] http://www.intergraph.com/about_us/default.aspx

[2] http://www.intergraph.com/ppm/customers/awards/goldenvalve/2013.aspx

[3] http://www.youtube.com/watch?v=q72xV36iuQM&feature=player_detailpage

[4] http://conference.hexagon.com/

Acknowledgment

Let us take this opportunity to congratulate each other on the exceptional work being done in PGESCo and also give special congratulations to the SUEZ project team for their extraordinary modeling efforts. The complexity of your design captured the imagination of the Intergraph judges and ultimately first prize. I would also like to specifically thank Kishore Kona, Ayaad Hegazy, & Mohamed Safwat for their efforts with SmartPlant Review which was used to generate the first place winning image.

WRITTEN BY:

Sherif Al-Ganady:

Sherif is currently Senior Plant Design Engineer working in both Baiji and South Helwan Projects which are both running the SmartPlant Enterprise Platform. Sherif received MSc in Artificial Intelligence (Neuro-Fuzzy Control) in Vehicle Dynamics from Helwan University in 2009.

Samer Tageldin:

Samer is currently the PGESCo SmartPlant Project Manager responsible for the SmartPlant Enterprise Platform Implementation.

Development of OTS for Ain El Sokhna Project

Introduction

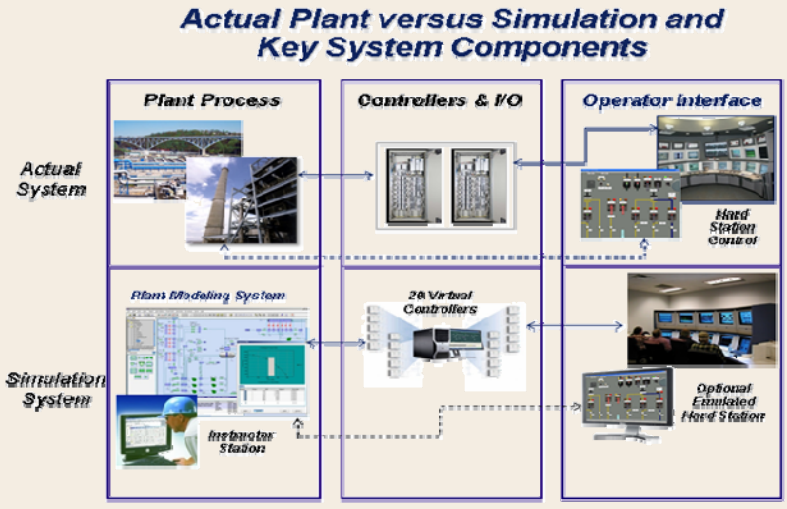
The change of the power plant operator interface from hard panel to personal computers Human Machine Interface (HMI), together with the introduction of high speed computers and networks has introduced new concepts for power plant simulation methods.

The actual plant main components which are mainly the plant process (Boiler, Turbine, BOP), plant control system (DCS Controllers and Input / Output Cards), and plant operator interface (Operator Station) are realized in the simulator through the plant modeling system, virtual controllers and operator control stations respectively.

The OTS has proven to be an exceptionally powerful tool in a variety of key operational areas, including operator training and knowledge transfer, engineering studies for operational improvements and de-bottlenecking projects. Customers that choose the OTS solution are able to:

- *Identify and eliminate issues during the design stage, long before the actual plant construction.*
- *Achieve a quicker and safer start-up and shutdowns, while reducing downtime.*
- *Increase their plants' reliability throughout their life cycle by facilitating evaluations of critical control strategies, improving responses to abnormal situations, reducing operating errors.*
- *Explore alternative options and optimize plant performance during operations.*

Figure (1) below shows the differences in the key system components between the actual plant control system and the simulation system.



Plant Model Types:

The **Power Plant Process Model** may be approached from different point of view depending on the purpose for which the model is intended and are classified as follows:

a. Low Fidelity Tie-back Simulator:

A **low fidelity tie-back simulator** uses time-lagged basic loop tie backs for understanding control strategy of a unit component, verify control loops, simulation of inputs and outputs. It is a valuable engineering and testing tool but it is not an effective tool for operation training. There is no dynamic behavior of process variables inside this type of simulators.

a. High Fidelity Simulator:

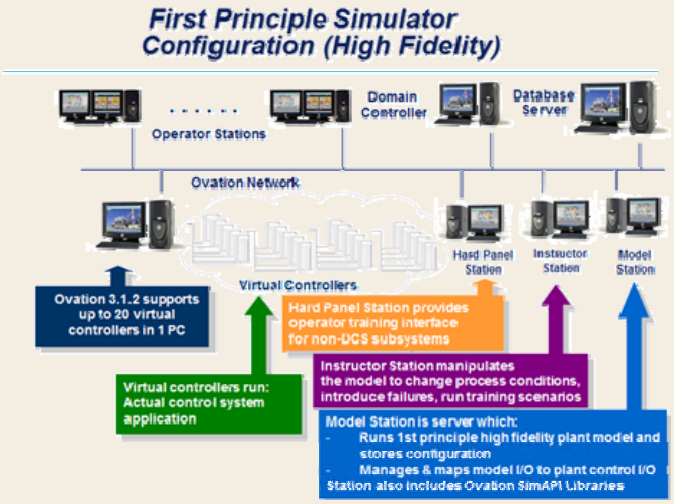
A high **fidelity simulator** uses first principles and design data to allow system simulation over a wide

range of operation (nonlinear model). It is based on laws of physics, conservation of mass and energy; parameters have physical meaning (surface area, heat transfer coefficient, Reynolds number etc.). It assesses the control strategy of all unit components, pre-evaluate process equipment changes. It is an excellent tool for operator training and controls optimization.

The high fidelity OTS provides real-time simulator to match the dynamic behavior of single or multiple plant units and their associated control and emergency shutdown systems. OTS is a computer and model-enabled system used to provide plant or unit operators with realistic operation environment to effectively learn how to operate the target process on which a unit runs. The training can range from normal operations to any abnormal conditions, as defined in pre-configured scenarios which are deployed by an instructor, for which the system provides a separate work station.

The following diagram shows the basic components for Emerson-Ovation high fidelity simulator:

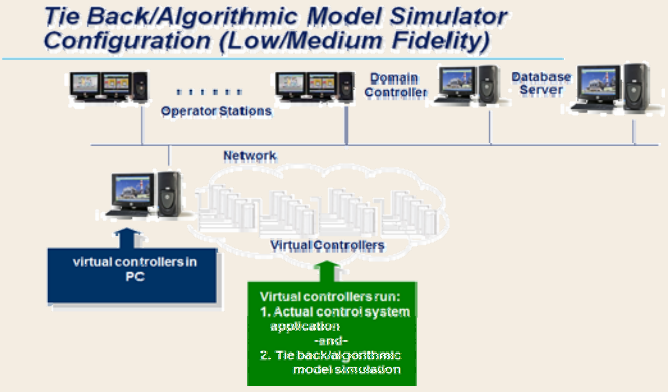
The following is a comparison between the different types of models in terms of cost, complexity, and the benefits of each type to the engineer, operator and management.



Medium Fidelity Tie-back Simulator:

A **medium fidelity tie back simulator** uses standard algorithms; typical response times transfer function, empirical formulas and basic interlocks. It tends to be linear. Furthermore, it is used to understand control strategy of a unit component, verify control loops before implementation, with limited operation functionality. Dynamic changes of process variables are available inside this type of simulators.

The following diagram shows the basic components for a tie back/algorithmic for Emerson-Ovation low/medium fidelity simulator:

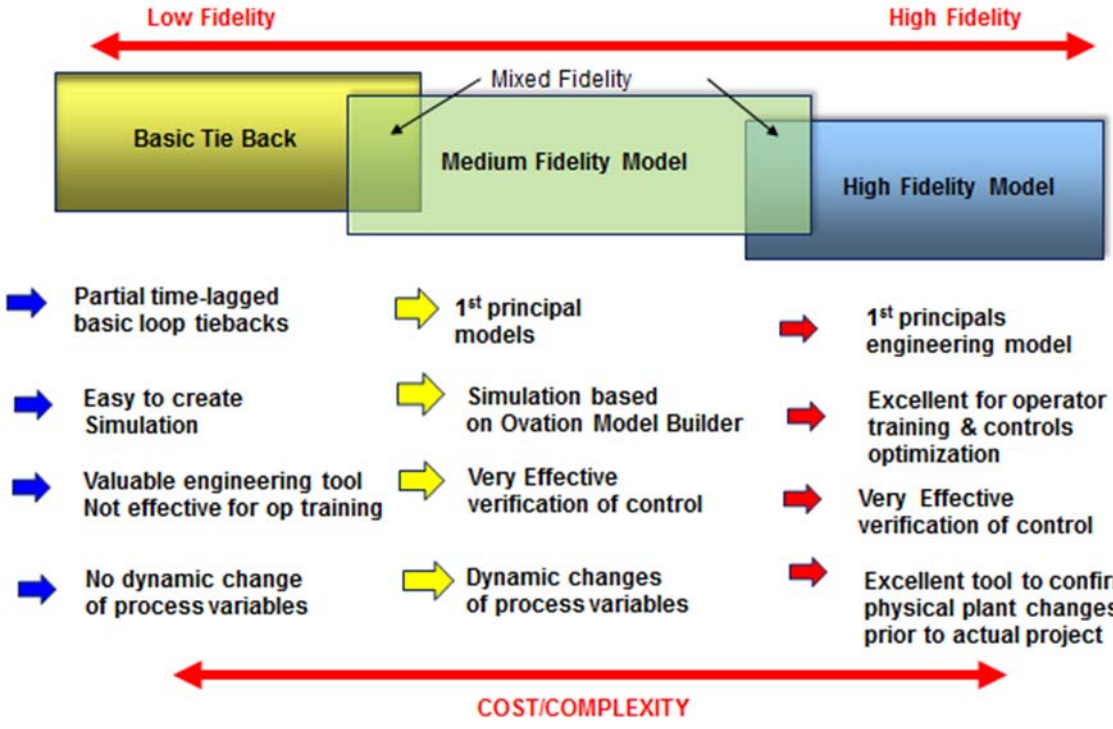


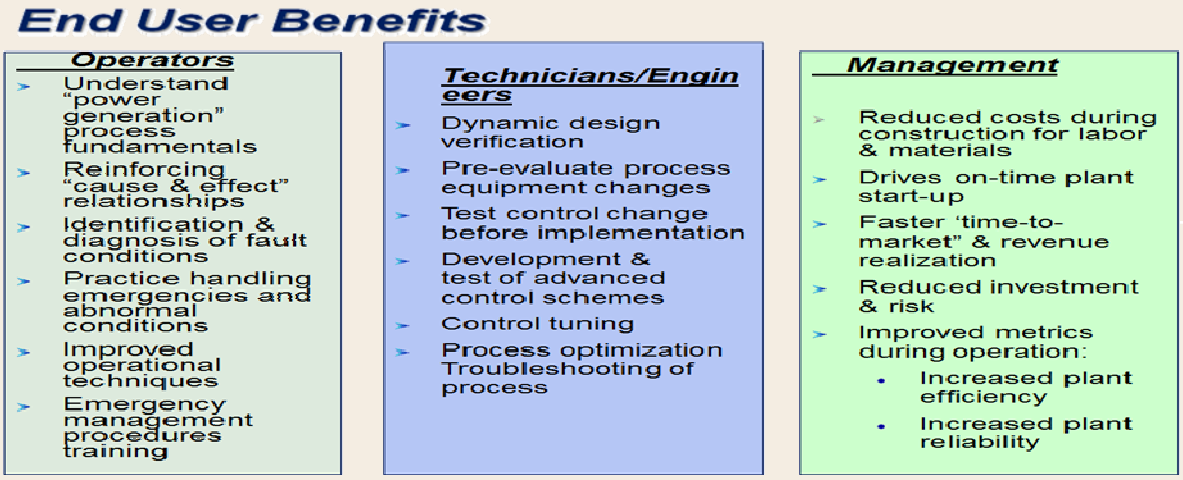
Benefits for Simulator systems

Third Party DCS

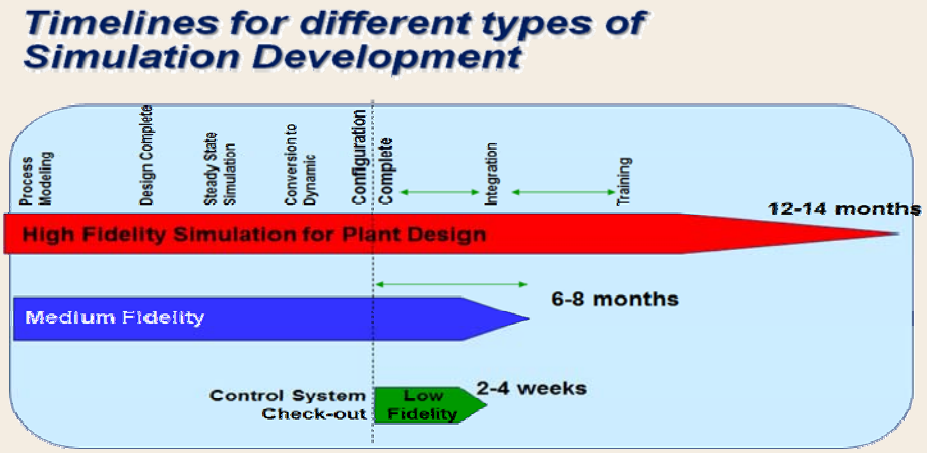
Tie-Back Low- Fidelity	Medium Fidelity Technicians/Engineers	High Fidelity Management
➢ Understand control strategy of a unit component	➢ Assess control strategy of all unit components	➢ Assess control strategy of all unit components
➢ Verify a few control loops	➢ Dynamic control design verification	➢ Dynamic control design verification
➢ Limited Start/Stop functionality	➢ Pre-evaluate process equipment changes	➢ Pre-evaluate process equipment changes
➢ Simulates only Ovation I/O	➢ Test control before implementation	➢ Test control before implementation
➢ No third party simulation	➢ R & D Tests of advanced control schemes (less time in the field)	➢ R & D Tests of advanced control schemes (less time in the field)
	➢ Can include third party control software	➢ Can include third party components
		➢ Assist end-user in new NERC regulations

Plant Model Alternatives vs. Simulation Cost/Complexity/Value





The simulator development varies from 2 - 4 weeks for low fidelity, 6 - 8 months for the medium fidelity and to 12 – 14 months for the high fidelity



Al Ain El Sokhna Project OTS

A high fidelity OTS solution is provided by ABB Italy for Al Ain El Sokhna Project. The high fidelity OTS simulates/emulates the real plant system components inside the control room.

El Sokhna high fidelity OTS is modeled according to physical laws, such as conservation of mass and energy, equipment datasheets. The systems are parameterized to produce the values prescribed by the applicable heat balance. Configuration characteristic data are used from equipment data (characteristics of pumps, fans, valves, etc.) If these data are not available, engineering empiricisms is used. Also a functional model for some equipment is built. A set of behavioral rules are identified and implemented and important cause- and-effect rules are taken into account for these equipment. OTS provides simulation/emulation of the different real plant control systems (DCS, TCS, BMS, BFPT plant auxiliaries PLCs, etc.). The different plant control systems are simulated / emulated through virtualization of plant control system software (DCS) (Configuration of logics, graphic displays, alarms, etc) or emulation of other control systems using functional logic diagrams and equipment descriptions.

El Sokhna OTS infrastructure consists of the following as shown in the architecture figure:

- DCS Virtualization Server with DCS Storage Archive. The server is used for virtualization of DCS to simulate the DCS process controllers, I/O, logic, alarms and all the HMI, faceplates, pop-ups. The Server runs the high fidelity replication of DCS through the virtualization of 800xA ABB DCS system
- Simulation server which contains the following:
  * Plant module, which contains the models of all plant equipment under the scope of the simulation. Levels, speeds, pressures, enthalpies, temperatures, flows, stream compositions and more are calculated in the plant model according to physical laws, such as the conservation of mass and energy, equipment states and parameters, such as valve positions, tank volumes and feeder speeds, or according a functional model. The plant module forms the heart of the simulator. It is built using a simulator platform.
  * Emulation of other equipment control systems (Steam Turbine and Generator Control, Burner Management System, Boiler Feed Pump Turbine Control, Auxiliary Boiler) based on functional code diagrams, HMIs, and equipment descriptions.
  * Emulation of the different PLCs for different equipment (Bearing Lubrication Skid, Air Compressors, Travelling Screens, and Self-Cleaning Strainers) based on graphic displays, flow charts, and equipment descriptions.
- Instructor station, by which the training is managed, generic or specific malfunctions are created and training scenarios are configured.
- Three DCS operator stations. A replica of the real plant DCS operator stations.
- One DCS engineer workstation. A replica of the real plant DCS engineer workstation.
- Three miscellaneous systems operator stations, supporting the HMI emulation of the emulated control systems.
- An Ethernet TCP/IP for data exchange and transmission of data and commands among the servers and computers.
- Graphic wall system and two printers.

For the period from September 2012 the OTS development team from ABB has been moved from Italy to PGESCo office to complete the OTS development inside PGESCo control systems lab under the support and supervision of PGESCo. The OTS hardware has been installed in PGESCo office on February 2013. During this period PGESCo provided full support of the OTS development team for any information/clarifications required to complete the OTS development. Internal tests have been conducted for the OTS and OTS was ready for FAT on April 03, 2013.

During the FAT, the following have been conducted:

- OTS completeness checks
- OTS communication Checks
- OTS instructor functions checks, on which all instructor functions that handle the OTS have been tested.
- Complete unit cold start-up up to full load and unit shutdown according to the instructions provided by the steam generator and STG supplier representatives which have been available during the test.
- OTS accuracy tests in which the steady state output of the model is compared against the equipment expected performance data.
- Critical events (runbacks, load rejection)
- Instructor malfunctions

Conclusion

The OTS is an exceptionally powerful tool for operator training and knowledge transfer, and engineering studies for operational improvements. PGESCo developed and implement this solution for Ain El Sokhna super critical power plant project, which is the first of a kind in Egypt, in order to identify issues during design stage and achieve safer start-up and shutdowns as well as increase plant reliability.

Authors:

Eng. Mostafa Khattab

Eng. Mervat Mohamed

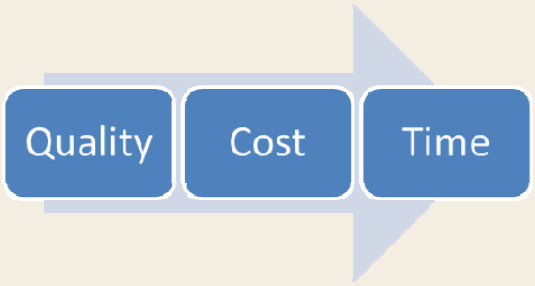
How Mail Center participates in building PGESCo infrastructure

Mail Center is the section that is responsible for the distribution of all kind of mail among PGESCo departments, and the communication focal point between PGESCo and other parties, (Clients , Owners, Suppliers , Governmental authorities , ..etc.).

The mail center was created at the beginning of 2005 with one person as staff. It became one of the main sections supporting PGESCo's infrastructure.

The section is maintaining all incoming and outgoing documentations to all destinations (international and domestic) including PGESCo head office and jobsites.

Mail specialists are keen to maintain the receiving and the delivery of the documentations, with the best ***quality,*** in the ***shortest time***, at the minimum ***cost.***



Quality is maintained in all means keeping:

- ***Confidentiality***
- ***Urgency***
- ***Reliability***
- ***Attention to Fragile Packages***

The mail section is using an automated system to record,, control and retrieve all acknowledgment receipts using hand held instrument applying barcodes , to record the exact delivery time.

Receiving documentations are filtered through very accurate verification steps to assure the received documentation quality. In addition, the mail center is controlling the mail transportation daily schedule to jobsites and Owner offices.

PGESCo, TRANSMITTAL / ACKNOWLEDGMENT OF RECEIPT:

Date: 11/27/2012

ID NO. : 10063-9-TCE-GAM-00962

Subject: Giza North 1500 MW Combined Cycle Power Project

Gas Terminal Interface Point

Recipient: Eng. Kamal Wafek W/I

Name:

PGESCo's reputation as a TRUSTworthy caliber organization is not only because of its EPC experience but also because of its support activities and the strong infrastructure that is not provided by other competitors.

By: Samy Farag

Mail Center Supervisor

PGESCO NEW TECHNIQUE FOR TRANSIENT ANALYSIS OF PIPING SYSTEMS

Background

Pressure surges and fluid transients, such as steam and water hammer, are events that can occur unexpectedly in operating power plants causing significant damages. When these transients occur the power plant can be out of service for long time, until the root cause is found and the appropriate solution is implemented. In the past this type of transient analysis, such as the steam hammer due to turbine stop valve rapid closure, were performed outside of PGESCo.

In searching for root cause of transients, engineers must investigate in depth the fluid conditions in the pipe line and the mechanism that initiated the transients. PGESCo recently added new tools and training for the central stress analysis engineers by using of PIPENET (Ref.1) and Caesar II (Ref.2) programs. These new tools allow the engineers to (a) model the transient mechanism (b) calculate hammering forces and (c) check its effects in causing possible damage to the pipeline. Having these new tools, engineering can also be proactive and analyze some of these transients during the design face of the project and add appropriate restraints to mitigate the effect of transients.

Introduction

PGESCo recently added new tools and engineering capabilities to perform complete dynamic analysis of transients encountered in operating power plants. The transient types that can be analyzed include:

- Steam hammer due to rapid valve closure
- Water hammer and slug flow
- Pump trips due to pump starts and stops
- Cavitation analysis due to collapse of cavities

The new capabilities and training use the PIPENET and CAESAR dynamic module programs. These programs allow PGESCo engineering to investigate in depth the causes of transients and find appropriate solutions in the piping design.

PGESCo engineers trained in the advanced dynamic module of CAESAR and PIPENET programs performed recently the steam hammer analysis of Suez thermal plant Main Steam system. The analysis generated first the time history hammering forces due to rapid closure of the main steam stop valves, using the PIPENET program, and second, applied these forces into the pipe stress analysis model using both time history and spectrum analysis methods (see Fig.1).

Verification of PIPENET and CAESARII results

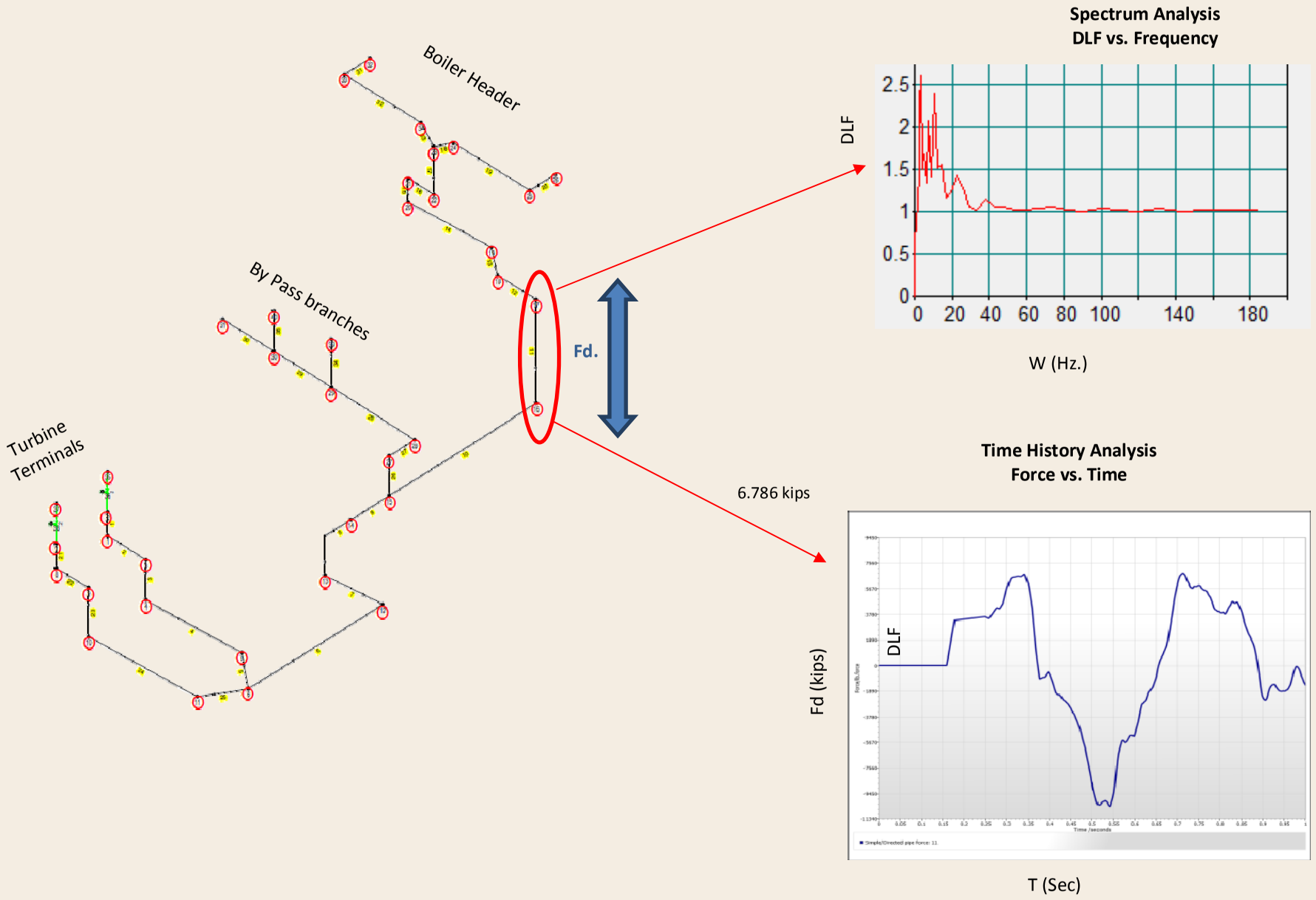
- The maximum segment forces calculated from PIPENET program was compared with the forces calculated using standard static methods and the comparison was in good agreement.

The restraint loads from time history analysis using CAESAR II program were compared with the loads using the BECHTEL standard ME-101 program and comparison was in good agreement.

Table 1. PIPENET and static approach results.

Section No.	Segment No.	Excel Sheet (kips)	PIPENET (kips)
S3	6	15.33	15.71
	7	9.18	9.99
	8	4.79	5.26
	9	12.26	12.74

Fig.1 - Transient Analysis of
Suez main steam line



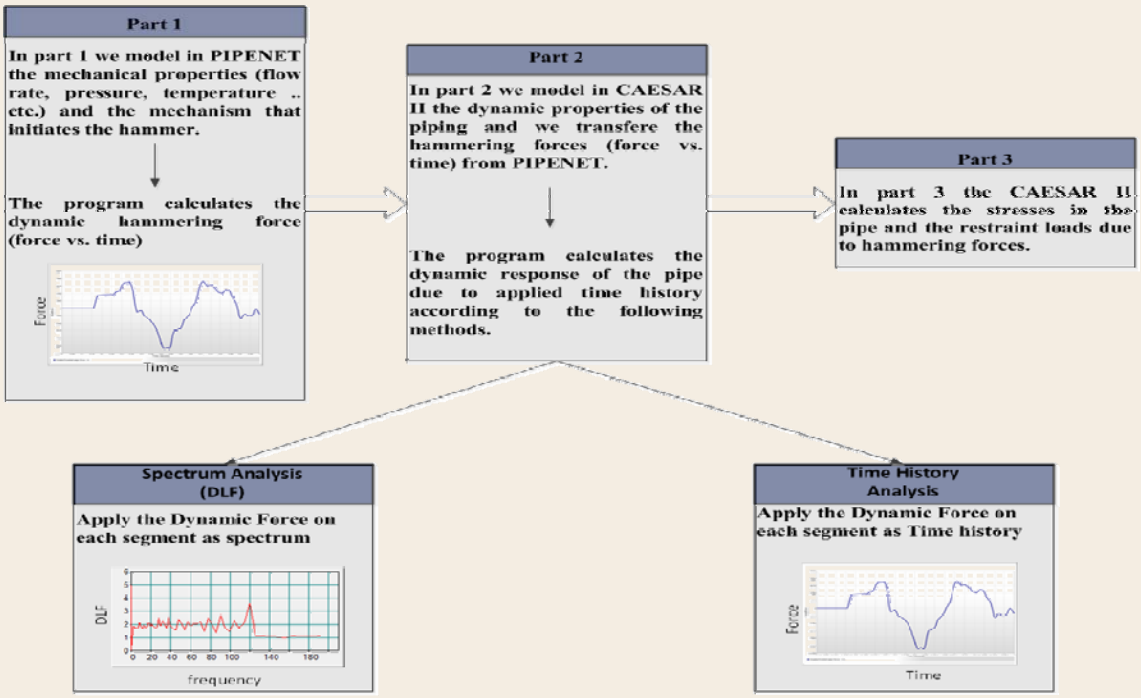


Fig.2 - Work Process Diagram

Conclusion

Adding this new capability makes PGESCo engineers able to study and analyze the transient scenarios in the piping systems and enables them to include appropriate solutions in the piping design.

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1. PIPENET VISION Transient Module Software Revision 1.6 © 2011 Sunrise Systems Limited User and Reference Manual.

2. CAESAR II 2011 Technical Reference Manual, Copyright © 1985-2011 Intergraph. All Rights Reserved.

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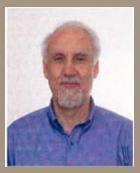

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Stress Analysis Engineer

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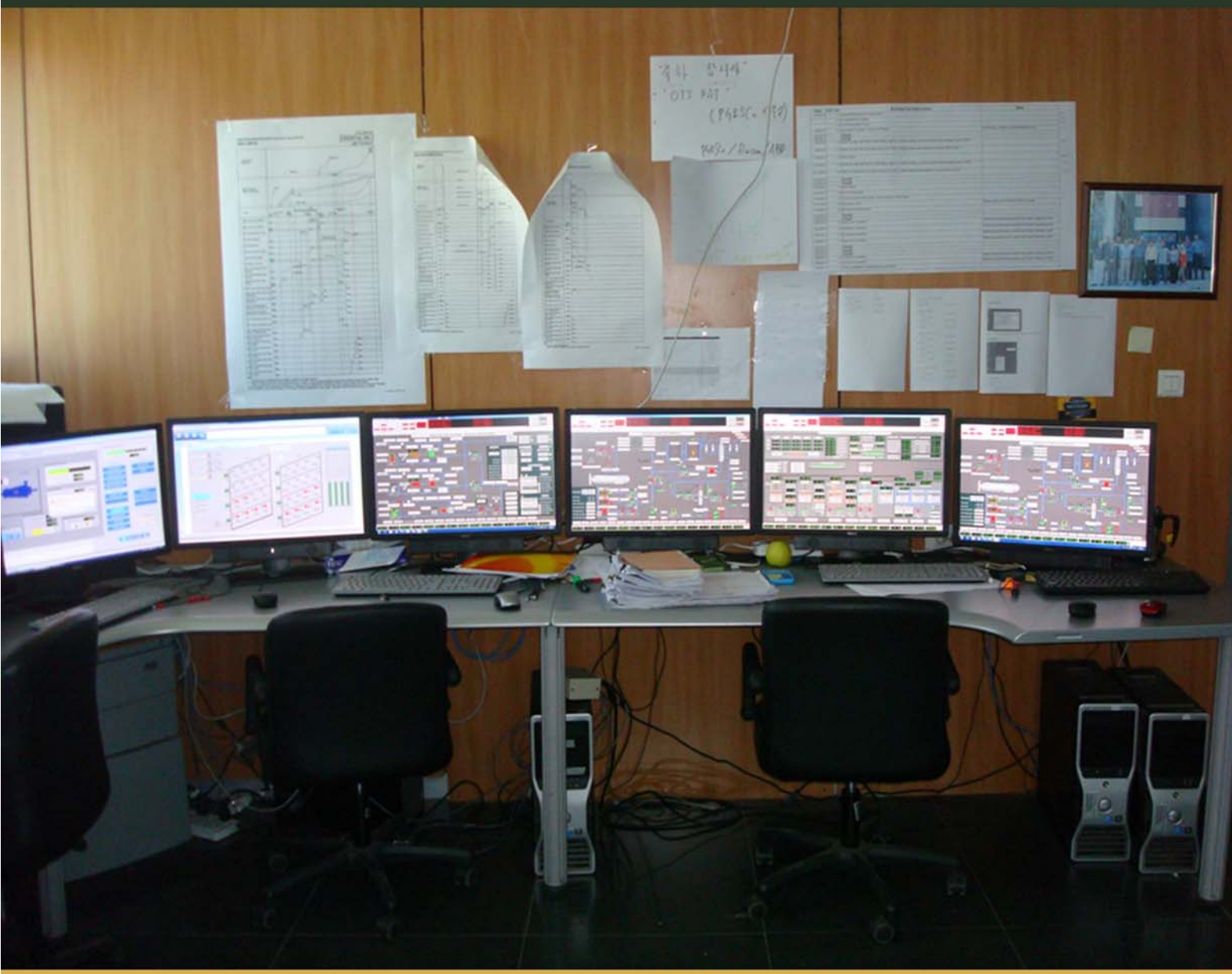

Development of OTS for Ain El Sokhna Project

“OTS under testing in PGESCo office”