H/Sched

Premier Operations Scheduling Systems

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H/Sched is the name given to Haverly's scheduling software platform. Using H/Sched, systems may be readily developed to handle virtually any operations scheduling situation that may exist in the hydrocarbon transportation and processing world. H/Sched systems are developed to specifically address the particular scheduling concerns of the user's operation. Haverly has found that due to the broad differences in operating configurations and philosophies within the industry, taking such a custom approach with its scheduling software is much preferred over an assumption that all operations can be forced into some kind of "one-size-fits-all" system.

H/Sched is comprised of several components, each of which may be readily customized to fit the particular needs of its scheduling application. These components themselves provide for superior:

- *Model construction and maintenance,*
- *Scheduling data handling and visualization,*
- *Scheduling simulation and (if required) optimization,*
- *Reporting and software integration.*

Haverly has been involved in the development of scheduling software for over twenty years. Over this time we have gained a vast wealth of experience and technical expertise in the scheduling of hydrocarbon operations. All this expertise is reflected in our H/Sched products. Following is a discussion on the application of H/Sched and its components.

A. PLANNING VERSUS SCHEDULING

A discussion on scheduling should begin with how it differs from the planning functions many associated with hydrocarbon operation modeling are familiar with. Planning is often performed using a tool such as linear programming (LP) to provide an operation wide balanced and/or optimized strategy for one or more discrete periods of time in the future. This technology lends itself well to longer range projections where individual events affecting an operation may be reliably averaged over the periods in which they occur, or ignored as having minimal effect in the long term. But in scheduling, the decisions required are often immediate, and the events affecting the operation, regardless of their size, must be discretely handled. The placements and durations of these events in time must be determined from the scheduling software. This implies that time itself becomes a variable.

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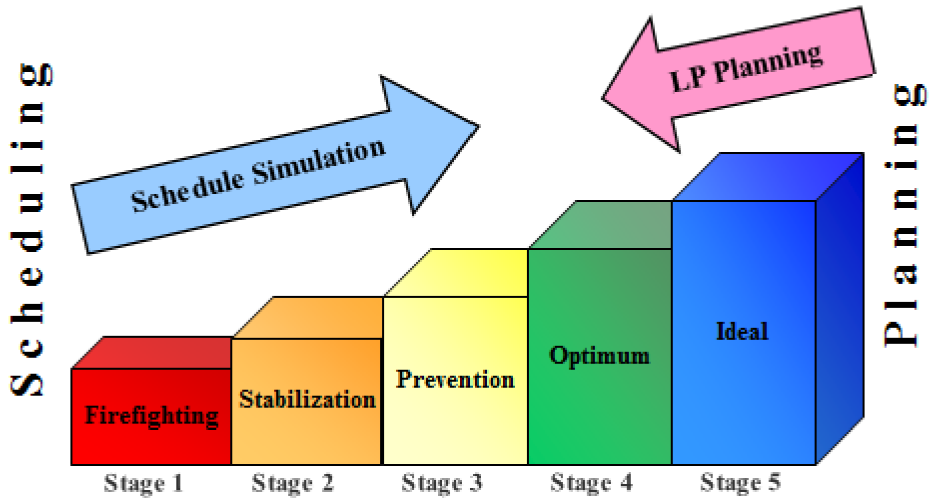

FIGURE 1 – OPERATION PROJECTION STAGES

FIGURE 1 shows the stages an operation might be projected to be at. Given that those stages nearer the SCHEDULING axis are related more to shorter term decision making, where profits are often secondary to smooth operation, one can see where and how scheduling and planning software applies. From the Planning axis, it can be said that a planning LP (Linear Program) model begins with unrealistic *ideal* conditions, upon which real operating constraints are applied which move the solution "down" to *optimal* conditions.

Scheduling, on the other hand, begins with fully unmanaged conditions. The first duty of any scheduling software is to provide a platform with which the scheduler can quickly determine how to control the impact of future situations (as well as current unplanned events). This first stage is therefore called *Firefighting*. Once all such events are under control, the scheduler has time to use the software to reassess and modify his responses, to project a *stable* operation, making better use of resources. Once stable operations are projected, the scheduler may further apply his simulation software to forecast how the operation might be better prepared to *prevent* future disruptions due to a changing scheduling environment. Schedule simulation alone, however, cannot be further extended to predict the very best or *optimal* operation possible.

So there is generally a natural gap between the optimized plan and the best schedule. This gap may be bridged in any of three ways:

1. Heavily constrained short term LP models which mimic actual operations,

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2. Schedule simulation augmented with special decision making logic, which programmatically provides the best response to known scheduled situations, or
3. Schedule simulation, manually performed with optimal operation parameters set as targets.

Method #1 generally leads to overly complex models which still do not contain the degree of operational flexibility required in the shorter term, and is therefore usually impractical. Method #2 also generally proves inflexible, given its response behavior is mostly pre-determined for various conditions and situations. Method #3 is by far the most common way of bridging the gap -- although it often requires a "trial and error" approach which works towards optimal operation targets, as well as an understanding of why such target may not be achievable in real time. But such an approach is often attractive because the knowledge and experience of the scheduler himself, which is usually superior anything that can be built into a software system, becomes more of an integral part of the final solution. In many applications, Method #2 type optimization components might be included in a Method #3 approach, to effectively provide some decision making ability and reduce necessary trials.

B. MODEL CONSTRUCTION AND MAINTENANCE

Construction of an H/Sched model begins by merely "drawing" a flow diagram of the operation. H/Sched provides a utility called the Model Generator for this purpose. FIGURE 2 shows an example of the primary Model Generator screen (for a fairly complex operation). A model is built in a Microsoft VISIO fashion, through clicks and drags of facilities to their positions in the operation. As facilities are added, the user enters the physical scheduling data pertaining to that facility into the model. Once the operation has been completely defined, the schedule simulator, as well as most graphical user interface and reporting instructions, are automatically generated. The drawn flow diagram also becomes part of the user interface for displaying some scheduling results and data. Users may later return to the Model Generator if any physical modifications to the operation need be made.

C. USING H/SCHED

H/Sched has been designed to be as intuitive and user friendly as possible. It makes

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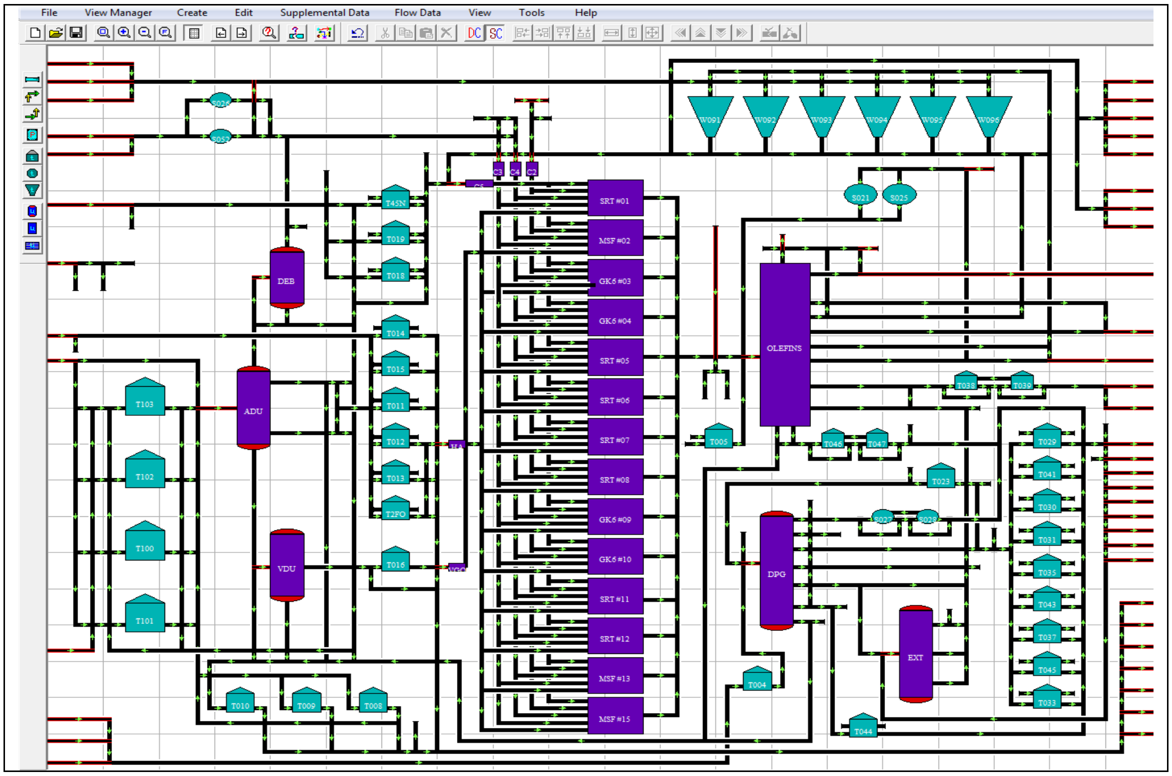

FIGURE 2 – MODEL GENERATOR EXAMPLE

heavy use of graphics to display scheduling data, directives, and results – in a wide variety of formats, enabling users to quickly realize and react to predicted situations and operational conditions. FIGURE 3 shows a small sample of the graphical formats available in H/Sched. Each graphic is produced into its own window, which may be viewed full screen, or configured into savable arrangements, such as that shown in FIGURE 3. Windows may also be redefined to show:

- specific times or time segments -- by day, week, or month
- user assigned coloring, font sizes, etc.
- user specified sub-groupings of scheduled operation activities, and
- zooming, as well as user defined views.

The window a user works from most is the one containing the schedule Gantt charts. From this window, a user can easily call up any of the other scheduling graphics, as well as:

- import (export) data (scheduling results) from (to) other software systems
- perform inventory and other data reconciliation activities
- add, delete, move, and otherwise modify schedule events and activities
- perform schedule simulation and optimization activities
- manage scheduling cases
- access online documentation and helps, and

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- display tank graphs by quantity, quality, and composition – grouped or singular.

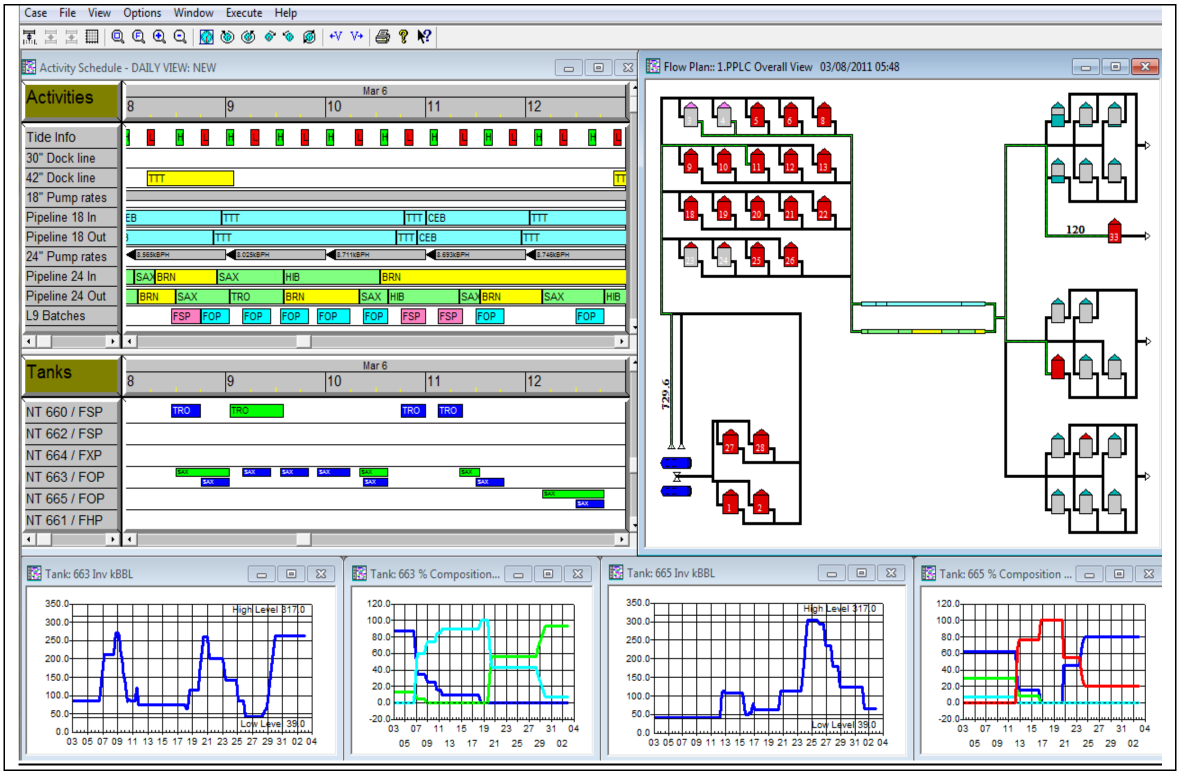

FIGURE 3 – H/SCHED USER GRAPHIC EXAMPLE

All scheduling results are also sent to a database, from which reports, work orders, and interfacing files specific to the scheduled operation may be generated to convenient Excel spreadsheets. FIGURE 4 shows an example of this reporting feature.

D. CONCLUDING REMARKS

Our experience has taught us that no two operations scheduling projects are the same, and each requires its own software solution. Haverly's scheduling tools have proven themselves to be extremely flexible and capable of being applied to any situations presented. Haverly stands ready to assist in the assessment of scheduling requirements and the development of scheduling systems. Various evaluation approaches are available to assure that H/Sched will meet a user's needs -- including our constructing a prototype model of a segment of the operation prior to full licensing.

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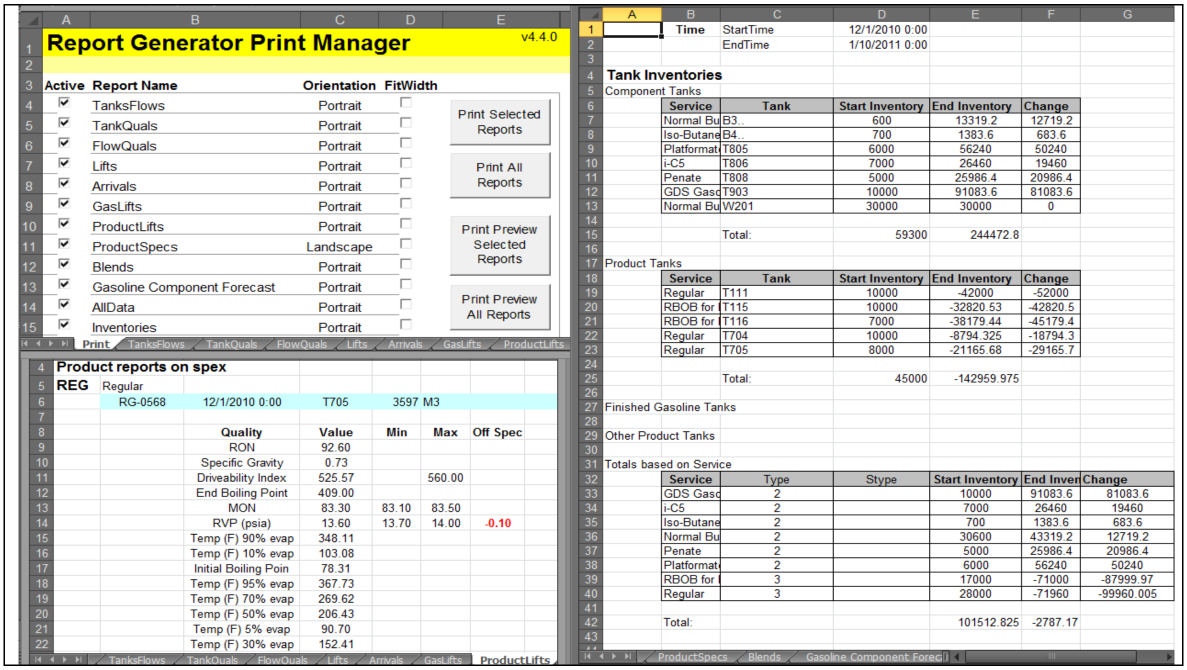

FIGURE 4 -- REPORT GENERATOR EXAMPLE

I haven't yet seen a better scheduling tool! Haverly works very custom orientated and is always interested to deliver a good solution within a short time.

-- Manuela Aßmus, BP

By inputting the butane deliveries and their respective compositions into the H/Sched model it allows us to look forward in time and determine if there are any interventions required with respect to quality or quantity issues.

-- Tom Jackson, Nova Chemicals (Canada) Ltd.

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