

Nanghai revisited

Interview with lead engineer for instrumentation and control Mr Teun Hooftman



The April 2005 issue of Valve World included an article looking at the 4000 control valves being specified for the massive Nanghai project in China. This follow-up article takes control a step further, looking at the 60-odd severe service control valves that have been specified.

By David Sear

They may only have taken up to a small portion of his time during the engineering stage, but critical control valves are a subject about which Mr Teun Hooftman is very passionate. As a lead engineer for instrumentation and control, and from over twenty-five years experience, Mr Hooftman knows that inappropriate selections can have far-reaching consequences during start-up and during the operational stage of the plant later on.

This is something his colleagues at Nanghai are also discovering, and indeed Mr Hooftman is often called upon to provide

expertise outside his own area (OBSL), such as the steam plant, EO/EG, etc. In short, if there is a critical issue regarding control valves, Mr Hooftman is invariably involved. Mr Hooftman: "Although the engineering has been done, when my colleagues would look more closely into the applications they can identify around five to ten per cent of cases where problems with control valves may be expected. I am then called in to try and troubleshoot.

These critical control valve applications should have been identified during the engineering stage and suitable type control

valves should have been ordered. Troubleshooting during construction and commissioning is possible but it cost a lot of money and creates delays."

One of the first tools that Mr Hooftman will use in that respect is the CONVAL software developed by German company FIRST. "It would be very difficult to troubleshoot critical applications without it," he notes. "It is possible to do the troubleshooting with 'hand' calculations but it will take an enormous amount of time. The standard control valve sizing products available from the valve manufacturers



Mr Teun Hooftman is a lead engineer for instrumentation and control at CNOOC and Shell Petrochemicals Company Ltd. He has been working on the Nanghai project from January 2003, located first in Beijing and since April 2004 in Nanghai itself. His primary area of responsibility is OSBL engineering, construction and commissioning (Off Site Battery Limit installations), although he also provides control valve troubleshooting for other areas.

derstandable interest in selling their own products and perhaps do not properly consider operational problems which may occur at a later stage. Sales of spare parts seems to be a large part of many manufacturers' turn-over. It should be noted that CONVAL software is independent from any valve manufacturer and the results are therefore unbiased."

Minimum flow

Asked if he could provide a concrete example of troubleshooting, Mr Hooftman discusses the minimum flow bypasses on pumps. "The valves used here are in many cases critical applications, although most engineers and especially the majority of the control valve manufacturers, don't appreciate that. They see it as 'just a bypass'. Now, when the system is in the steady-state condition, with a normal minimum flow through the valve of 80%, then everything will probably be fine. However, of course you will also have to start-up the pump every now and then. Following every shut-down, for example. That means you initially run the pump at

100% through the bypass and start bringing the facilities on. So more flow is diverted to your facilities with less flow through the bypass valve to contain the minimum flow of the pump. In other words, you start controlling between say 80% and 0% and then you run into the critical areas. If you only look at this one operating point given by the contractor then you are missing out on the critical regions of the control valves, and that's where most of these control valves will be destroyed by cavitation, by erosion and so on."

"If end users moved towards EPCM contacts (Engineering, Procurement, Construction and Maintenance) I am sure we would get much better control over the total life cycle costs. For control valves this means, better selection for the whole range of flow, including start-up and commissioning."

Further discussing low flow pump bypass valves, Mr Hooftman said that critical applications at Nanghai were being met using SAMSON's globe-style control valves. "We anticipated, with the help of CONVAL, that rotary designs would soon become damaged in such an application," he says. "In principle, the leading manufacturers all had suitable products, but SAMSON best appreciated our concerns about the potential for cavitation erosion and damage. That is something which is clearly laid out in Shell's Design Engineering Practice (DEP) guidelines, that cavitation should be avoided by applying valves with better critical parameters. The DEP also states that if you still have cavitation then you should use orifice plates or multi-stage trims, etc. But the best approach is to firstly apply valves with better critical parameters, such as globe type valves. The majority of the

themselves are almost invariably based on operating points only. So if the engineer (consultant or contractor) just gives one set point that is all the manufacturer will consider. Suppose he takes 80% opening as the set point. That means the calculations completely ignore the ranges from 0% to 80% and from 80% to 100%. When you use CONVAL, you can predict the whole range. Moreover, the intelligence in the software allows you to see where problem areas may arise, this from the graphic presentation and 'alarm' identification. In my personal view that is something the manufacturers should be more knowledgeable and forthright about."

Mr Hooftman continues: "My view, from experience and discussing critical applications with control valve manufacturers yearly, is that many of them have an un-



LEUSCH triple eccentric butterfly valves with special trims have been specified for the cooling water systems.

control valve manufacturers are supporting this except for the ones only selling one type of control valve.

A good example is that some control valve manufacturers would provide a solution with only a rotary valve and an orifice downstream to prevent cavitation. To me this is an unacceptable design because it merely shifts the cavitation damage from the valve trim and body to the restriction orifice and therefore to the pip-

ing and nearby bends. This will protect the manufacturer's reputation but creates a potentially unsafe situation for the customer especially in ethylene oxide service."

Triple eccentric

List the severe service control valves at Nanhai, however, and you won't just find globe valves. Triple eccentric butterfly valves are also being deployed, says Mr

Hooftman, pointing out the 60" models being used in the cooling water systems. "The pumps here are rated at 38,000 to 40,000 cubic metres per hour," says Mr Hooftman. "The lines to the pump are 60" going into a header of 2.6 metres. The initial design philosophy indicated that two valve in series would be required: a gate valve plus a ball valve downstream of the pump for start-up. Given the high cost of two valves we looked for ways to reduce the costs and came up with this triple eccentric butterfly valve, with class V or VI tightness." Again, some of the leading triple eccentric manufacturers were approached to design what in essence would be an on/off valve. SAMSON came back with the warning, though, that when the pump was started up, severe cavitation on opening the valve would be evident.

Mr Hooftman: "With noise levels predicted in the 100 -115 dB(A) range, the cavitation would have destroyed the valve. The solution from LEUSCH (a member of the SAMSON Group) was to fit special trims and this solution is working well. With the special low noise disk design we have seen noise levels up to 80 dB(A) but no higher, which is pretty good." ▶

Project background

The Nanhai Petrochemicals project is one of the largest capital investment for a Sino/foreign joint venture project to date in China.

The joint venture partners (50/50 Shell Nanhai BV / CNOOC Petrochemicals Investment Ltd) are building and will operate a USD 4.3 billion petrochemicals complex in Daya Bay, Huizhou, Guangdong Province, China. Products are primarily for the domestic market.

The project encompasses: an integrated chemicals complex, including steam and electricity generation; storage, handling and shipping facilities; effluent treatment and environmental protection facilities.

The heart of the complex is a naphtha cracker producing 800,000 tpa of ethylene and 430,000 tpa of propylene. Total output will be 2.3 million tpa of products including glycols, polyols, LDPE, HDPE, PP and MPG.

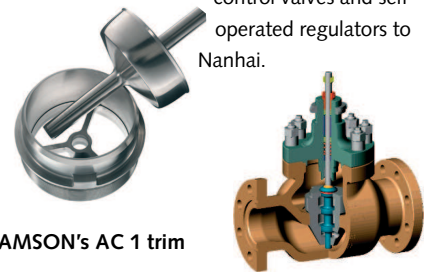




Mr Hooftman: "It is important to design control valve applications also for start-up and commissioning conditions which may be very different. If not part of the engineering, a reliability problem may increase life cycle cost and may influence production targets."

Severe service control valves at Nanhai-OSBL

- Main supplier: SAMSON.
- Key designs: globe and triple eccentric.
- Features: AC1 and AC3 Trims on globe valves to reduce noise emission produced by cavitation.
- Features: Silencers fitted to some triple eccentric valves.
- Total order: The SAMSON Group is supplying a total of 571 control valves and self-operated regulators to Nanhai.



SAMSON's AC 1 trim

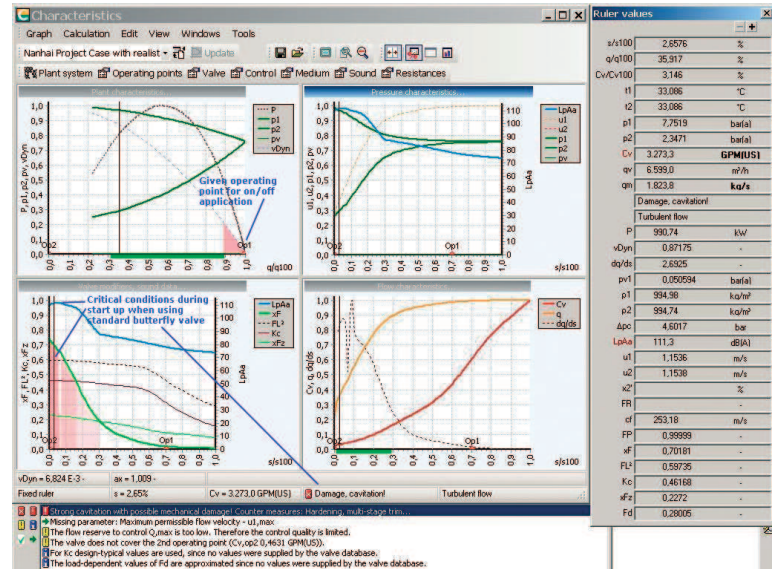
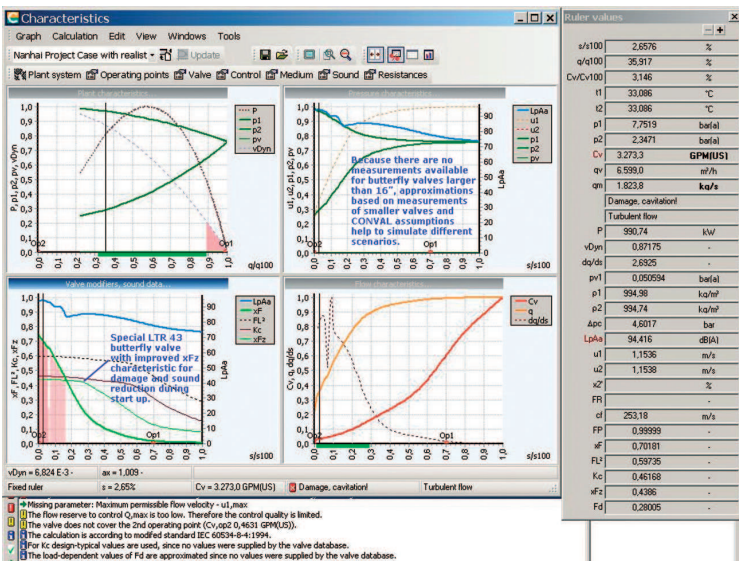
Control valve fitted with AC 3 trim

"When choosing a control valve manufacturer, I consider expertise just as important as cost."

Some sixteen of these valves were ordered for Nanhai, although Mr Hooftman admits he did have to defend the extra purchase cost. "I was asked whether the trim was really necessary, given that the valve may only be in the critical area for

some 30 to 90 seconds. However, even that is long enough to destroy the valve. Perhaps not the first time, but certainly after a number of start-ups." His resolution has since been vindicated. "What nobody appreciated at the time was that the rotating equipment engineers would need to test their pumps. To create the necessary resistance downstream, they are running some triple eccentric valves at between 10% and 30% open for up to four hours! This is definitely not what the

valve was intended to do. So I am very happy that we took this decision to specify this particular valve with its anti-cavitation trim otherwise it would have been destroyed before the plant was even started up! The learning point here is to design control valve applications also for start-up and commissioning conditions which may be very different. If not part of the engineering, a reliability problem may increase life cycle cost and may influence production targets." ■



CONVAL graphics showing the difference between standard and delivered special disk butterfly valves.