

# The Linde Easter story — demise and resurrection of a compressor

**The fact that it is Easter**, the most important feast in the Christian calendar, is suddenly irrelevant, although the symbolism may pass fleetingly through your mind as you speed through telephone lists and parts numbers on the way to a solution.

This is exactly what happened in the Linde (former BOC) Air Separation Plant in Maanshan, Republic of China, earlier this year. 19th March in fact. Within 24 hours the damage was identified, recorded and analyzed. Impeller A had suffered a 7 cm crack on one of its blades. As no deposits had built up it could be deduced that the crack had only recently occurred. The crack had opened up as the impeller expanded and very slight damage was caused to the contour ring on the circumference of the impeller.

The impeller needs to be replaced for service to continue. Outage means lack of production. But the customer has no spare rotor. What should be done? The Linde branch in Nanjing, just three hours away by road, has a similar rotor with an identical impeller. Could that be used as a substitute? This was the key question. Some six months earlier, Siemens and Linde had made the observation that such a swap would be complicated by different tooth width and higher rotation speed of the pinions. In the event of a problem it would be necessary to change the entire gear set, including contouring and volute inserts. Some adjustments to the oil spray bars, the volute casings and some stator parts would also have to be made. Additionally just swapping the impeller and

the contour ring could be a practicable alternative.

But it is not just a question of resuming production, although that is the immediate imperative. It is just as important in the long term to find the root cause of the incident and prevent the same thing from happening again. It was decided that local engineers from Siemens China would investigate Impeller A in more detail when the compressor was dismantled. This would be done on Easter Sunday — March 23, 2008. Siemens China asked the customer to send the damaged impeller back to the manufacturing and service center in Duisburg, Germany, for fact-finding — and of course to clarify whether or not it was a warranty issue.

Meanwhile, it was decided that the spare Nanjing impeller could indeed be used. Telephones started buzzing, e-mails flew back and forth. Not only Siemens China, but also Linde's own organization, were working flat out, to secure the spare rotor, arrange balancing, to hire or liberate a crane for the disassembly. Four days of solid work ensued, to disassemble the rotor, transport it to the new site, and reassemble it. By 28th March — nine days after shutdown — the replacement equipment was installed and was tested in situ the following day. The immediate crisis was over.

The schedule was hectic as can be seen from the log of Martin Stiegler, Siemens' Service Director based in Beijing:

**19th afternoon** — customer experienced first shutdown

**19th late afternoon** — customer found crack on Impeller A

**19th (11pm)** — call to Siemens (Martin) from Linde Platform team in Shanghai (Bob)

**19th midnight** — advised local Siemens engineer (Zhang Zhong Fei) to mobilize to site immediately).

**20th morning** — got on first flight and arrived at site at 11am. (Zhu Jun, Martin, Zhang Zhong Fei).

**20th afternoon** — after discussion with customer decided to dismantle compressor.

**21st** — mobilized two additional Siemens local engineers (Yan Bing Guang and Meng Xiang Yu) to help with dismantling.

**22nd** — mobilized Siemens local Senior Engineer (Bu Shao Feng) to help with dismantling and assembly

**23rd–26th** — dismantling, balancing and reassembly.

**26th** — demobilized two additional Siemens local engineers (Yan Bing Guang and Meng Xiang Yu)

**27th** — mobilized foreign Siemens engineer (Mr. Ketteler) to site (called off from other site) for final check and start-up.

**28th** — start-up of compressor

**29th** — check on running status

**29th afternoon** — demobilized Siemens engineers

The relationship between Siemens and Linde enabled the closest and unquestioning cooperation based on mutual trust. Of paramount importance to all involved was to

“Practice makes perfect; and patience and people make perfect performance!”

resolve the problem with a prompt and satisfactory solution, and to take action to prevent the same type of incident from occurring again or elsewhere in the fleet.

In the aftermath of this crescendo of activity, some conclusions can be drawn.

- **Response** — The response and mobilization were very rapid as local engineers could be deployed
- **Priority** — Because of proximity and networking it was possible to bring in a Siemens engineer from another site.
- **Preparation** — The Linde platform team had previously written general technical clarifications (2007) on the interchangeability of the spare parts. This degree of preparedness saved considerable time when the shutdown occurred.
- **Open communication and trust** — Speed was of the essence, so it was agreed to carry out all work without purchase orders or decisions on liability.
- **Excellent Linde internal cooperation** — Maanshan site worked very hard, provided cranes, mobilized the rotor from the Nanjing site, balanced the rotor and provided support labor.

As a corollary to the story, Siemens is currently closely discussing spare parts and availability strategies with Linde and has signed several contracts for capital spare parts to ensure availability in the unlikely event of damage. The original VK125 compressor was delivered in 2005 to BOC, an English company purchased by Linde in 2006.



**Linde's representative, General Manager Gordon Wang, comments on the incident:**

*“Obviously it is extremely unfortunate when your equipment breaks down for any reason, but we cannot complain about the diligence and dedication of the Siemens engineers once the breakdown had happened, especially from service team China. We so appreciated their great effort. The cooperation with our engineers*

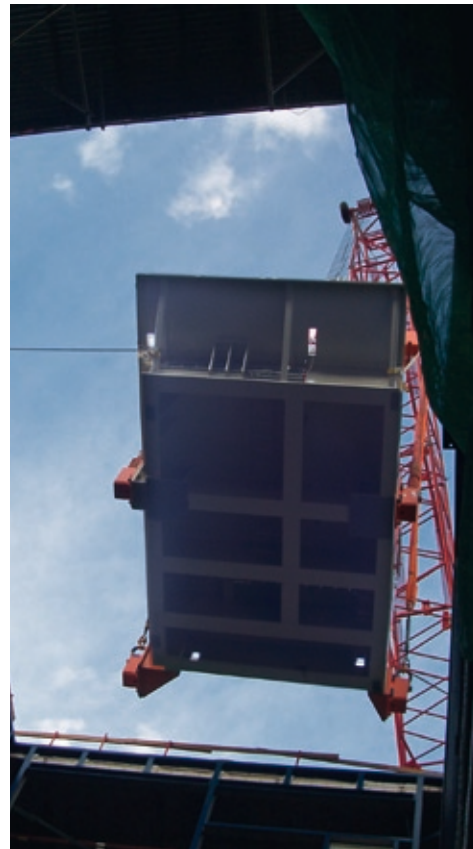
*on site was immediate and comprehensive. Within ten days our plant was fully operational again, and we have every confidence that Siemens will analyze the root cause of the incident to ensure that there is no repetition.”*



**Martin Stiegler from Siemens' service team China:** *“The root cause analysis has taken longer than we anticipated, but we do not want to cut corners or there is no point in carrying out the analysis. Our customer understands that it is in his and our best interests to drive the analysis to a successful conclusion, so that we can finally shake hands on a job well done and one that will not have to be done again. Practice makes perfect; and patience and people make perfect performance!”*



Summer concerts were held around the event in front of the GuD1 building — with the SGT-800 standing behind the scenes.



A massive 250-tonnes mobile crane lifted the two packages — 90 tonnes each — through the roof of Würzburg's HWK combined heat and power plant.