

SAFETY IN THE OIL AND GAS INDUSTRIES IN QATAR

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The oil and natural gas industries in Qatar have a very good safety record. Yet this performance is achieved without any government agency that is the equivalent of the UK Health and Safety Executive (HSE) or the US Occupational Safety and Health Administration (OSHA). Neither is there any legislation that is analogous to the Health and Safety at Work act, or to Control of Substances Hazardous to Health (COSHH), Control of Major Accident Hazards (COMAH), Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), *ATmosphères EXplosibles* (ATEX) or Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). There is no organization like the Chemical Safety Board (CSB) that disseminates information and lessons that can be learned from specific industrial accidents. Despite this the safety performance of the process industries is a commendable success story. It is an excellent example of how responsible project partners can self-regulate their activities and how meticulous, and almost obsessive, attention to safety training can lead to spectacular safety performance. This is so even when tens of thousands of relatively unskilled workers are involved in the plant construction phase. Some examples are given from individual companies as well as some of the conceptual principles around which training can be delivered. Other industrial sectors in Qatar have far less enviable track records, for instance civil engineering construction and road transportation. This simply highlights the quality of senior management in the process industry sector.

KEYWORDS: Industrial safety, accidents, incidents, lessons learned, education, training

BACKGROUND INFORMATION ON QATAR

Obtaining reliable statistical information about Qatar is difficult and details are often contradictory. Sources of information include websites and newspaper reports with quality standards that may be variable. What is certain is that it is a peaceful and stable nation formed of a peninsula of 11,437 km² approximately half way along the western coast of the Arabian Gulf. Its population is variously reported between 1.1 and 1.54 million (an increase of more than an order of magnitude since the 1960s) of which approximately 200,000 are citizens. 70% to 80% of the population lives in the greater Doha area. Qatar has proven reserves of 27.4×10^9 barrels of oil (2.2% of the world's total) with a reserves to production (R/P) ratio of 62.8 years. More importantly it has 14.4% of the world's natural gas reserves at 25.6 trillion m³ and with an R/P ratio well in excess of 100 years, ref. BP Statistical Review, 2008. These reserves are being developed aggressively and by the end of the decade Qatar will be the world's largest exporter of LNG. But downstream processing is also being developed so, for instance, QAFCO (the Qatar Fertilizer Company) is the world's largest single site exporter of urea. Rapid developments are taking place in the process industries and in improving the infrastructure of the country in terms of civil engineering projects (a new airport, improved utilities, roads and tower blocks for company headquarters, hotels, apartments and the Pearl offshore development for example.) These, and massive developments in the field of education, mean there

are probably in excess of 1 million expatriates who live and work in Qatar: some are on short-term contracts whilst others may have lived here for generations, ref. Qatar Foundation website. Qatar is a wealthy nation: the International Monetary Fund quotes its GDP at \$86,700 per annum per head of population, a figure that places it near the top of world rankings where it vies with Lichtenstein and Luxembourg for the number one slot.

Before oil and gas were discovered pearl fishing was the main source of wealth: Qatar's pearls were famous for their lustre, translucency and quality. The hazards and risks associated with being a pearl diver were significant with little equipment other than a rope to the boat above and lead weights to help you reach the sea bed below. A few of the older citizens still remember these times and how the nation's economy collapsed as a consequence of Kokichi Mikimoto in Japan developing the technique for producing cultured pearls. The present royal family is wise enough to realize that the current oil and gas based economy will also collapse or subside sometime, perhaps when some science or technology breakthrough allows us to have a hydrogen based economy with production derived from water and solar energy? But if that were to happen Qatar is still blessed with an abundant supply of the latter! Even without new technology the oil and gas economy must also eventually expire as reserves dwindle. That should not happen in Qatar for more than a century but before it does Qatar is determined to transform its

economy into one based on knowledge rather than hydrocarbons alone. Hence the rationale for creating the Qatar Foundation, and Education city, which are key elements of Qatar's economic development.

QATAR FOUNDATION, EDUCATION CITY AND TAMUQ

Qatar Foundation for Education, Science and Community Development is a private, chartered, non-profit organization, founded in 1995 by His Highness Sheikh Hamad Bin Khalifa Al-Thani, the Emir of Qatar. It was established "as a vehicle to convert the country's current, but temporary, mineral wealth into durable human capital," ref. Qatar Foundation Annual report. This simple statement recognizes that the only true long lasting investment that can be made for the future is in people.

Education City, a 14 million m² (3460 acre) campus on the western outskirts of Doha, is the practical manifestation of such investment. It is already home to schools, universities and the Qatar Science and Technology Park (QSTP), and will eventually include the national library, a teaching hospital and an international convention centre. The universities already present include Texas A&M University at Qatar (TAMUQ), Carnegie Mellon, Georgetown University School of Foreign Service, Virginia Commonwealth, Cornell University's Weill Medical College and Northwestern University. Two Canadian institutions, the College of the North Atlantic and the University of Calgary, as well as Stenden University from the Netherlands also operate from other campus locations in Doha as does the University of Qatar which was originally formed in 1973 as a College of Education. The Emir's wife, Her Highness Sheikha Mozah Bint Nasser Al-Missned, is the Chairman of the Qatar Foundation and is widely seen as having been instrumental in many of the new education initiatives in Qatar.

In 2006 the Emir announced that Qatar would spend 2.8% of its GDP on government funded research. The equivalent rate in the US is 0.83% and in the EU was 0.63% in 2004, ref. QSTP website. Part of this expenditure is channelled through the Qatar National Research Fund (QNRF) in the form of support for internationally peer reviewed research proposals.

In 2004, Qatar established the Qatar Science & Technology Park (QSTP) at Education City to link the Education City universities with industry and to help develop Qatar's post carbon economy. Twenty-one companies including household names such as EADS, ExxonMobil, GE, Rolls Royce, Microsoft, Shell, Total, Chevron and ConocoPhillips have already committed \$225 million of research and development investment at QSTP.

INDUSTRIAL HEALTH AND SAFETY LEGISLATION IN QATAR

The title of this paper is "Safety in the oil and gas industries in Qatar". With the rapid development of the process industries, of the national infrastructure and of R&D it is

revealing to question what national organization(s) are responsible for industrial health and safety. The answer, like many things in Qatar, is not simple as the State of Qatar has no single Ministry or agency with the equivalent responsibilities and/or powers of, for instance, the HSE, OSHA or the CSB. Responsibility is diffuse and resides in the Ministries of Labour and Social Affairs, of Health, of Municipal Affairs and Agriculture and of the Environment as well as the Department of Civil Defence, ref. AlBaker et al. Within the National Labour laws Articles 99 to 107 do deal specifically with "safety, vocational health and social care". These articles can be precised briefly as follows and include statements that:

99. Employers shall formally inform employees of any work related hazards, of safe methods of work and of protective measures to be taken.
100. Employers shall protect their workers from injury and disease and shall make no charges to the employee for this. The department has the power of partial or total closure of a company failing to meet this requirement.
101. Workers shall do nothing to hamper or prevent employer's efforts aimed at creating a safe work place. They will follow instructions, procedures and will use protective devices.
102. The Minister will define equipment required for prevention of occupation ill-health and diseases.
103. Employers will arrange for good hygiene, good ventilation, suitable lighting and provision of potable water in the workplace.
104. Suitable numbers of first aid kits (one for every 25 people) will be supplied by employers employing more than 5 people. A full time medical nurse and a clinic with doctor and nurse are required in larger companies of specified sizes.
105. Regular medical checkups and record keeping are required in situations associated with possible occupational ill-health or disease.
106. In locations distant from cities suitable transportation and/or accommodation shall be provided as well as food and potable water.
107. For companies employing more than 50 people suitable social services shall be supplied taking into account location and circumstances.

Occasional articles in the national press remind companies of their need to comply with the requirements of specific parts of the Ministry of Labour law, see for instance "The Peninsula" of 8th April 2009:

"Under labour law 14 2004, statistics are required including":

- A list of the work injuries.
- How and when the injuries took place.
- The procedures taken accordingly by the company and a list of the ailments of the profession.

And similarly announcements from the Ministry of Labour to owners of businesses and companies are

occasionally placed in national newspapers: those relating to Health and Safety Precautions, and printed in the same issue of *The Peninsula*, are given below but are paraphrased for the sake of brevity:

- The work environment must provide protection to all those present.
- That provision of PPE must be at no cost to the employee.
- Proper warning signs, posters and labels must be used.
- There must be prompt and proper disposal of industrial wastes.
- There must be proper levels of ventilation, cleanliness and water supply.
- Open holes and ditches must be surrounded with railings. Nets should be used for prevention of falls from construction sites for tower blocks and high rise buildings.
- Staircases must use non-slip materials and have safety features.
- Steps must be taken to deal with high/low temperatures at the work site, *e.g.*, with provision of head gear and cold water, gloves and warm clothing.
- For work away from built up areas automated transportation should be provided and periodically checked.
- Electrical wiring must be safe.

Similar reminders of necessary fire and safety precautions were presented at the same time and in the same reference. These included:

- Use of fire proof materials where possible.
- Provision of suitable emergency exits.
- Ensuring that furnaces and boilers are of appropriate construction.
- There should be no smoking in the workplace.
- Raising awareness and training the workforce in fire prevention and use of fire-fighting equipment.

These statements, and the promise/warning that “The Ministry of Labour will be conducting extensive on-site inspections to make sure that the above are followed and respected” should make it clear that there is a basic framework for industrial safety: there is also increasing effort devoted to enforcement. However there is little from government sources by way of more detailed legislation, requirements, guidance or statistics.

THREE DIFFERENT APPROACHES TO REDUCING ACCIDENT RATES IN QATAR

With the summary of Qatar’s industrial health and safety legislation presented above one might expect that safety records in the process industries would be poor. In fact the converse is true: but this is not the case in all sectors of industry, something we will illustrate shortly with brief comments about safety in civil engineering (as opposed to process engineering) construction and road traffic accidents. Detailed statistics are not available but from circumstantial evidence we think that standards of industrial health and safety in Qatar vary quite widely between different sectors

of industry. In this section we look briefly at three approaches to reducing accident rates. There is nothing new in these, but they highlight different philosophies with very different chances of success.

THE QATAR PROCESS INDUSTRIES – ENFORCEMENT ACHIEVED THROUGH EDUCATION, TRAINING AND INVESTMENT IN THE INDIVIDUAL

Qatar Petroleum is state owned and is the major stakeholder in most of the Qatar’s major investments in the process industries. Partners include world class companies such as Maersk, Elf, ExxonMobil, Shell, Total, Occidental, Chevron, Sasol, and many others. These companies bring with them top rate expertise in project management in general, and health and safety management systems in particular. The detailed structure and specification of the health and safety management system, and the standards of performance expected, may thus vary quite widely between projects, with the use of different standards (usually US or EC), goals, and auditing procedures. But the quality of performance is derived largely from the quality of the QP partners and their desire to follow best practice.

As a first example the Qatar Chemical Company (QChem), a joint venture between QP and Chevron Phillips, which manufactures polyethylene, follows OSHA and National Fire Protection Association (NFPA) guidelines in all their operations. It monitors compliance with safety policies, programs and procedures by means of both internal and external auditing. Workplace injuries are properly investigated for root cause identification with the aim of preventing recurrence. Every employee is empowered, and expected, to stop unsafe work practices. QSafe, the QChem behaviour based safety program, is employee driven and all employees are expected to report unsafe work practices, *ref.* AlBaker et al., 2008.

As a second example consider Ras Laffan Industrial City (RLIC) which is 80 km north of Doha. Massive, and diverse, projects there have included the need to employ and accommodate up to 165,000 construction workers on site in work camps. To put that into context, this is rather more than 10% of the population of Qatar: the vast majority of these are expatriates from relatively poor countries around the world. They are on short term contracts and have a relatively low level of formal education – though they may have high-quality trade skills. They come from diverse cultures and initially have very variable attitudes for example to health and safety, the use of PPE, or personal responsibility for their actions whilst at work. The success of the various partners at RLIC is that it is not unusual for these employees to work 20 million man hours (between 2 to 3 weeks) without a Lost Time Incident (LTI). This has been achieved by fully utilizing the experience and skills of the management teams within the partner companies that QP has selected. This knowledge is now being transferred to Qatari managers, thus enabling local industry to leapfrog the painful health and safety learning processes that the major partners have

had to experience over extended periods during their development. The best measure of the success of these policies would be a safety culture that continues to deliver enduring world class safety performance even after the majority of foreigners have departed the shores of Qatar.

The main onshore operations of both Qatargas and Rasgas are based at RLIC where gas from the North field, 90 km offshore, is received, processed and stored. In October 2008 RasGas completed 10 years without a single LTI within its offshore asset department. The announcement of this performance was accompanied by the words "safety and security is always of paramount importance at RasGas, whether in day-to-day operations or special projects. The RasGas target of zero LTI is in place at all times throughout the company operations and all RasGas teams rise to this challenge every day. This applies to all external partners as well as internal employees. RasGas' ongoing commitment to best practices and improvement programmes are central to the company's ethos," The Peninsula, 16th Oct 2008.

As a final example from the process industries we look briefly at Qatargas. Under the remarkable leadership of Chief Executive Officer Faisal Al Suwaidi, Qatargas has developed into a world class company. Part of this journey involved establishing the company "Incident and Injury-Free (IIF)" program in 2002.¹ Since that time more than 23,000 contractors and employees have been provided with tailor made safety courses. This is not token training and does not come cheaply. Everyone knows that the drive for this emanates from the very top of Qatargas and that positive safety behaviour is expected both inside and outside the company gates. Each employee also realises that they have both the right, and the personal responsibility, to ensure that any unsafe work practices are remedied. As a consequence Qatargas has a record of 4 years without an LTI onshore and 5 years without an LTI offshore, see "Delivering energy to the world", 2008. Qatargas also has the vision to impose analogous safety standards on their suppliers. For instance two out of 4 of the Q-Max and Q-Flex tankers, of up to 266,000 m³ capacity and associated with Qatargas train 4, were built in Korean shipyards without a single LTI. Similarly for train 5 tankers there was only 1 LTI for all 6 ships.

Parallels with the Hong Kong Mass Transit Railway (MTR)
Whilst preparing this paper Gordon Sellers (Sellers 2009) sent us a comment via e-mail concerning the Hong Kong Mass Transit Railway (MTR) in 1990. He said that the "MTR had a superb safety and operational record, despite very few formal safety systems. They attributed this to the highly experienced expatriates from the UK (London Underground) and from Sydney, who had managed the design, construction and early operation. But many of those expatriates were heading for retirement in the next 10 years, to be replaced by local staff who were very capable but had limited experience outside Hong Kong. Therefore the MTR decided that they needed to put in

¹Incident and Injury-Free is a registered trademark of MJM Associates LLC.

place a world-class safety management system. The success of that was measured by the continuing superb safety and operational record of the MTR."

THE QATAR CONSTRUCTION INDUSTRY – ENFORCEMENT THROUGH ADOPTING CODES DEVELOPED ELSEWHERE

Reports in the Qatar national press of construction site accidents are not unusual. For instance on 29th May 2008 The Peninsula reported the death of a construction worker at the Pearl Qatar project after he was buried in sand when a tunnel he had been digging caved in. Tellingly, the same article went on to say that "in a similar accident last February, a 52-year old worker was buried alive after sand and debris fell on him at a construction area in the West Bay. The man was busy excavating a tunnel to install a 35 metre long and 2 metre wide sewage pipe when a nearby tunnel collapsed. Last March a supervisor of a construction company died in another accident on site". Of course, newspaper reports are notoriously inaccurate in detail, but if correct, this one illustrates two things: 1, that internationally acceptable safe working practices had not been defined or followed and 2, that appropriate lessons had not been learned from previous analogous accidents. "Learning lessons" is the key to continual improvement in health and safety management and one of the fundamental foundations on which safety management systems described in the previous section have been built. It is the *raison d'être* for the Chemical Safety and Hazard Investigation Board in the United States, see ref. for CSB. They are to be commended for their accident and incident investigations, for the analysis and reporting and for making their findings available free of charge notably in the format of DVDs that can be used for teaching and education.

Further, in some senses similar, fatal accidents include the deaths of two workers when scaffolding collapsed, the deaths of four labourers when a crane that was being erected fell to the ground and the deaths of 6 workers when they were crushed as a boundary wall failed, ref. The Peninsula 7th May 2008.

Recent application of the Singapore building codes to Civil Engineering construction projects in Qatar may result in some improvement but our view is that education and training lie at the heart of this safety problem. The fact that the process industries 80 km north of Doha can run, in some senses similar, construction projects employing up to 165,000 expatriate, and relatively poorly educated, construction workers with excellent health and safety performance is irrefutable evidence that the time and effort that they have invested in training and education is reaping dividends – for everyone.

DRIVING AND ROAD TRANSPORTATION IN QATAR – ENFORCEMENT THROUGH TAKING PUNITIVE ACTION

Safety on the roads of Qatar is taken seriously by some but everyday experience demonstrates that this is not

necessarily translated into good driving habits: for instance all private cars must carry a fire extinguisher. But checks in a safety class that one of us was running recently revealed that most of the drivers present were unsure of how to activate their fire extinguisher, whether it had been serviced or checked recently or, in some cases, exactly where the extinguisher was mounted. None were sure whether the fire extinguisher was checked during a regular car service. This illustrates the point that rules and regulations are of themselves of very limited value. Indeed, without education and enthusiastic voluntary participation and compliance, the regulations may be valueless.

Statistics for the year 2000 (old, but the most recent that we could find) show that the fatal accident rate on the roads in Qatar is significantly lower than in some other Gulf States. Be this as it may, road safety is still poor by Western European standards. Last year in Qatar there were 10,000 accidents that resulted in 199 deaths: 25% of the fatalities were children, see "The Foundation", March 2009. Exact comparisons are difficult but this fatal accident frequency rate is of the order of 3 to 5 times greater than Western European norms. Practices such as gross speeding, not wearing seat belts, allowing children to stand unrestrained on the front seats of cars, using mobile phones whilst driving, close tailgating of cars in front and very poor lane discipline on roads and in roundabouts are all common. Another root cause of accidents is the financial ability of young, inexperienced drivers to buy and drive powerful cars. But it is easy to be critical. Until the UK seat belt law was introduced in 1983 many still chose not to wear them and to this day in the USA some States still do not require the compulsory use of motorcycle helmets.

Up till now the route that has been chosen in Qatar to try and improve road safety standards is based largely on punitive actions. Fines and possible prison sentences for instance for using mobile phones whilst driving (up to £1900 and prison for up to one year) or for driving with no license, having consumed alcohol or in the wrong direction on a one way street (up to £9400) may seem harsh. But enforcement is sporadic at best, and non-existent at worst, so seeing drivers using a mobile is still a multiple daily occurrence.

In issue 2 of "The Foundation", March 2009 it was announced that the UK Transport Research Laboratory would join the organizations based at QSTP. Their work will focus on innovative processes and technologies in road transport and developing local infrastructure, design of roads and traffic networks. However we feel that proposals such as to provide feedback on your speed with a "smiley" (or "grumpy"?) icon will of themselves fail. Again, significant improvements must be based on campaigns of education, training, possibly gruesome demonstrations of the potential consequences of driving actions, and a desire on the part of drivers themselves to improve their performance. Of themselves a few posters (a current tactic) will achieve little. Road safety campaigns need to start in the earliest years of school so that a new generation of drivers is produced for whom different patterns of behaviour become the norm.

THE SECRET OF GOOD HEALTH AND SAFETY PERFORMANCE LIES IN OBSESSIVE ATTENTION TO EDUCATION AND TRAINING

We have stressed that education and training are an integral part of the journey of Qatar towards a post carbon economy. In many places we have also stressed that investment in quality training is one of the foundations on which good health and safety performance in industry must be based. One of the companies who specialize in this work in Qatar is JMJ Associates and in this section we use material presented in one of their papers, see Strycker 2007. Figure 1 one shows the four quadrant model of process safety as presented by Strycker, albeit in a modified form. These quadrants as classified horizontally as "interior" or "exterior" and vertically as "individual" or "group". So the individual and interior quadrant define how someone plans to behave whereas the quadrant below it involves a group or collective. The safety values of the individual and the group within which (s)he works/operates must be aligned to avoid conflicts. Similarly the individual must align their intentions with their actual behaviour (top right quadrant). They do this because they want to, not because someone is watching, the rule book tells them to do so, or because they will face a large fine if they don't. Group alignment between the shared culture and the safety management system is required along the bottom axis and safety performance alignment ensures that individual actions are in accord with the intentions of the safety management system.

In an engineering context, central to all of these quadrants is the precondition that engineers have removed or minimized hazards wherever they can (*i.e.*, moved towards inherent safety), reduced the risks associated with

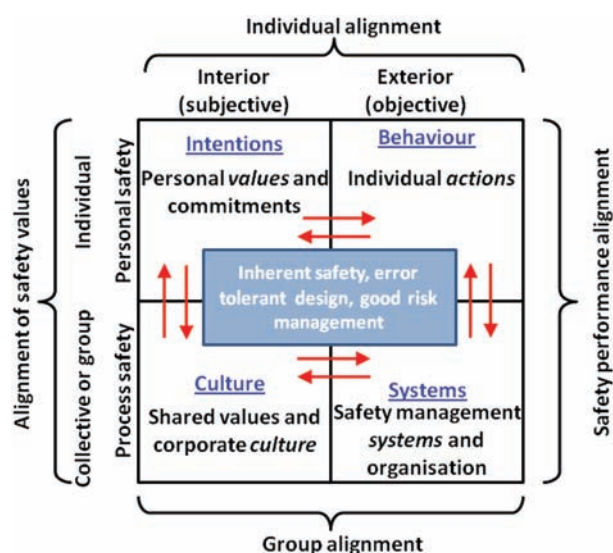


Figure 1. The four quadrant representation of industrial safety, adapted from Stryker (2007). No one quadrant can be self sufficient or independent: they are part of a single, integrated safety culture

the residual hazards as much as possible and generated an error tolerant or “robust” design. We believe that Strycker is correct to highlight that “personal safety” and “process safety” are simply different aspects of one entity. However, as discussed in the Baker report, Baker et al., 2007, separate programs should be put in place to track and improve “personal safety” and “process safety.”

CONCLUSIONS

Effective education and training lies at the heart of good health and safety performance in industry. The project partners in the process industries in Qatar have been highly professional at importing and applying their best international practices for health and safety management. As a consequence they, and their employees, are now reaping the dividends. In many cases excellent safety cultures have been nurtured and are now developing. As more Qatari nationals move into senior management positions they will inherit the best international standards of health and safety performance. Their challenge will be not only to maintain these standards but also to seek out further improvement.

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