SARS

Preventive plans key to managing health risk in a construction environment in China

By David W. Moore

PETROCHINA HAS IMPLEMENTED a western-style SH&E management system in the world's largest pipeline construction project—the 4,000km natural gas West-East Pipeline Project. The severe acute respiratory syndrome (SARS) epidemic in spring 2003 posed a risk to the project. This article describes the comprehensive approach implemented to mitigate this risk in a remote province of China. The strategy involved training, administrative controls, isolating the workforce, monitoring and daily reporting. Although the daily reporting introduced a significant administrative burden, it served as a constant reminder of the serious nature of SARS. After reporting for two months, the World Health Organization (WHO) declared the epidemic over, and SARS precautions on the project were relaxed. No symptoms or cases of the disease were observed among employees. The workforce learned from living through this experience and now is prepared to quickly respond in the event of a recurrence.

The SARS Epidemic

The SARS epidemic gained worldwide attention during spring 2003. Ultimately, a total of 5,327 residents of mainland China would contract the disease, with 368 dying as a result ("Chinese Experts"). SARS originated in south mainland China in November 2002 and spread rapidly around the world as a result of global travel. On March 15, 2003, WHO issued a travel advisory regarding SARS-related precautions if traveling to mainland China [WHO(a)]. In April 2003, the Chinese government, usually reticent to share such domestic information, admitted that the problem was more widespread than initially reported and began providing a daily detailed public accounting of the health situation within the country. The Political Bureau of the Central Committee of the Communist Party of China—the highest authority in China's ruling party—issued an order in mid-April to openly disseminate information on the spread of SARS and warned that any official found to be withholding or distorting information would be severely punished. In fact, 120 Chinese public health officials were dismissed or given disciplinary warnings in April for their slack reaction in addressing SARS ("Slack Officials").

By early May 2003, a total of 4,125 SARS cases were confirmed and 197 people had died in mainland China ("Chinese Mainland"). Of the 31 regions within mainland China, 25 had reported suspected cases of SARS. A total of 25 regions also reported suffering SARS-caused fatalities. At that time worldwide, 7,300 cases of SARS and 500 deaths had been reported in 30 countries. It was clearly a rapidly spreading disease with no medication proven to arrest its advance and no inoculation to avoid it. Although 50 percent of China's SARS fatalities occurred in Beijing, the lack of comprehensive medical services in remote Chinese provinces caused great concern regarding whether the epidemic could ever be controlled.

In the end, the SARS epidemic in China was reported fully contained only four months after being declared. On June 24, 2003, WHO removed Beijing from its list of SARS-infected areas and lifted its travel advisory for mainland China. The country released its last SARS patient on Aug. 16, 2003. These two developments were considered milestones in the epic worldwide fight against the disease. Anxiety remains high that SARS will return, however. In a recent national survey in China, 30 percent of respondents said they worry over a return of SARS [WHO(b)].

How did the remote provinces in China contain SARS? What evidence suggests that SARS can be controlled? Will the disease return? This article sheds light on these questions by identifying health measures taken by a major construction project in one of the most remote Chinese provinces. In some cases, these measures are unique to the culture and regulations of China; however, most incorporate sound risk mitigation practices that may prove useful to a workforce anywhere in the world.

The Pipeline Project

The West-East Pipeline Project (WEPP) is a massive infrastructure project to develop natural resources in remote areas of China (Photo 1, pg. 22).

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PetroChina is the primary project owner, with letters of intent to become partners in the development from Shell, ExxonMobil and GazProm. PetroChina is that nation's largest producer of crude oil and natural gas and is one of its largest companies. The pipeline connects the remote western province of Xinjiang to the city of Shanghai. The 1,016mm diameter, X-70 steel, approximately 4,000km pipeline will link clean-burning natural gas reserves in the Tarim Basin in the far west of China to the population centers along the eastern seaboard. The eastern half of the system began gas delivery in late 2003 with natural gas supplied from fields in the central region of China; the western half is scheduled to start up in late 2004.

The project is divided into six sites for construction management purposes. Site 2 is the longest of the six and is representative of the remote areas through which the pipeline passes (PetroChina). Site 2 is based in Wuwei, Gansu province, a remote agricultural area located in a high desert region of northwest China. Construction at this site will span a two-year time period—from early 2003 through startup in late 2004.

As noted, the project owners have incorporated a western-style SH&E management system into this Chinese-managed construction project. A construction supervision team (CST), managed by Universal Ensco Inc., Houston, oversees and manages daily construction activities. The CST office in Wuwei employs 45 people who manage seven section offices. Each section office has about 20 worksite quality and SH&E inspectors who are responsible for inspecting work activities daily.

The Site 2 office oversees construction activities in a 1,250km portion of the pipeline that includes Gansu and Ningxia provinces. Photo 1 shows a typical construction worksite along the pipeline route. While remote and in a high desert location, sizeable population centers (each with hundreds of thousands of residents) and many farming communities are found along this route. An environmental impact assessment was conducted as part of the route selection process. The routing avoids major population centers and in many areas follows existing railroads, major highways and power distribution corridors. Sensitive environments crossed in Site 2 include the Gobi Desert, Anxi Nature Desert Reserve, Shapotou Nature Reserve, the Hangsipu Agriculture Area and Yellow River (via an aerial crossing). The pipeline also crosses many minor rivers and salt marshes.

In addition to these sensitive environments, the pipeline passes through major agricultural areas where fruit and grains are grown. Most farming in this region is performed manually, so workers are in the fields during most of the construction season. Therefore, it is common for farmers to be in the immediate vicinity of the pipeline right-of-way during construction. The route generally follows the ancient Silk Road and crosses under parts of the Great Wall several times. The elevation is generally around 1,500 meters. The temperature from December through February ranges from -20ºC to 0ºC; summer temperatures range from 21ºC to 35ºC. While it is typically an arid climate, a monsoon-driven rainy season occurs from July through September. Construction is suspended whenever weather extremes would significantly hinder progress.

Cultural Differences Pertinent to SH&E Best Practices

The author has worked in China on several occasions. Besides this assignment in Gansu, he has provided SH&E support on projects in Hong Kong, the Shenzhen Special Economic Zone, Hainan Island and the South China Sea. Cultural differences definitely exist between the U.S. and the People's Republic of China, several of which played a critical role in implementing a western-style SH&E management system in a Chinese work environment. While these differences are not seen as absolutes, they manifest themselves as tendencies within the workforce.

A major tenet of a western-style SH&E system is open reporting of nonconformances, incidents, injuries and illnesses. The Chinese workforce generally saw no reward for self-reporting and believed that reporting anything negative formed the basis for punishment. Thus, the concept of open reporting posed a risk to be avoided. As a result, information viewed as detrimental to the work unit tended to be kept within the work unit and not reported up the SH&E chain of command. As a result, it was a constant struggle to ensure that nonconformances were properly identified, classified and reported.

Another barrier was the ratio of the cost of prevention to the cost of consequences. In the U.S., the cost of accident prevention is relatively low compared to the cost of the consequences of having an unsafe workplace. In other words, an economic incentive exists to invest in training and PPE to avoid lost worktime, increased workers' compensation, medical care, fines and liabilities stemming from accidents. A similar incentive did not exist in China. Workers are plentiful and the cost of labor is relatively cheap. Good quality safety equipment such as healthcare masks, eye goggles, ear plugs, respirators, and fall protection harnesses were a clear requirement, yet they were relatively expensive and difficult to obtain. Furthermore, enforcement by regulatory agencies was observed to be weak, and punitive damages are capped at a low level—$6,000. These factors combined to de-emphasize safe work practices in favor of accepting the consequences.

Another complicating factor was the Chinese belief that everything is perfect as long as balance (yin and yang) is maintained. An effective western-style SH&E system is based on the concept of continuous improvement—always looking for/communicating shortcomings and taking corrective actions to improve the system. Since balance was the goal of the Chinese, they saw little incentive to seek out and fix problems. As long as a vague (to the author) sense of balance was maintained, systemic problems were acceptable to the Chinese workers. The preference was for ambiguity instead of certainty. The author was even encouraged on many occasions to smoke and drink alcohol on the basis of balance—too many good habits are not good for you.

Combined, these cultural issues resulted in a challenging environment in which to implement a comprehensive western-style SH&E management system.

Pipeline Construction Method

Construction on this section of the pipeline is achieved by assigning qualified pipeline contractors to build specific sections. A total of 20 contractors and nine CST offices are present in Site 2, with construction activities divided into six sections. Thirteen construction contractors are present, with anywhere from one to four crews, each working at different locations. All told, the Site 2 portion of WEPP has a total of 4,600 workers.

Individual pipe joints in 12-meter lengths are

Visiting with the Locals: A Personal Perspective

One evening after an audit outside the city of Zhong Ning, a Chinese coworker invited me to visit his family. We both lived and worked in Wuwei 300km to the west, but this was the village where he had been raised. Although only a few kilometers outside Zhong Ning, the village is a separate farming area with few signs of a nearby city.

Most homes are built of mud mixed with straw, which is typical of the agricultural part of northwest China. In many ways, the scenery mimics that of northern Arizona and New Mexico. Homes generally consist of a one-meter thick, three-meter high wall surrounding several structures with beamed roofs and a central courtyard. Narrow streets are not named nor lit.

My coworker's parents no longer lived in the village but five of his uncles did. Each had a large, single-story walled home. Interior rooms were multipurpose. One served as the living room, kitchen, eating area and sleeping area for several people. Another area was a workshed with dozens of sheepskins stretched out for curing, while another was a mechanical room with a boiler and sleeping area. Some floors were tile, some concrete and others plain dirt. Some walls were mud; some were concrete. Each home had obviously been modified over the years to meet changing needs. Roofs were flat and served as storage areas—firewood, hay, surplus equipment, lumber, poles, etc. Children did homework while the adults watched TV. Cigarettes, tea and other drinks were offered several times. Everyone was friendly and curious about America and perceptions of China.

We returned to the hotel in the central part of the city after a few hours. Overnight, the local equivalent of the Neighborhood Watch called the hospital to report that a foreigner had visited the village. A medical team visited my coworker's family and checked temperatures as a precaution against SARS. Everyone passed. The hospital also contacted our hotel and confirmed it was in compliance with the Public Health Dept.'s SARS precautions.

delivered via railway to strategically located staging yards along the route. They are delivered by truck to the pipeline right-of-way three to four joints at a time. Construction contractors are responsible for clearing the right-of-way, stringing the pipe, welding pipe joints, trenching, lowering the pipe into the trench, burying it, restoring the right-of-way and hydrotesting the pipe. Five inspection contractors accept or reject each field weld based on nondestructive examination methods. The telecommunications contractor places small diameter high-density polyethylene (HDPE) pipe in the trench above the backfilled large diameter gas pipeline and inserts fiber optic telecommunications lines inside the HDPE pipe. One specialty contractor constructs access roads.

The entire workforce consists of Chinese contractors and Chinese nationals. A substantial portion of the workforce comes from other regions of China. Each contractor has established offices and living accommodations for its workers in cities along the pipeline route. These workers include supervisors, engineers, technicians, welders, heavy equipment operators, laborers, radiographers, quality inspectors and SH&E personnel. Unskilled labor is generally hired from local villages on a temporary basis.

Sufficient commercial infrastructure is present to accommodate personnel working at the site. Only one portable construction camp was required in the entire 1,250km of Site 2. Most contractors reside in hotels or commercially available housing facilities and offices. Typically, contractor crews have 30 to 40 people, who reside in hotels, apartments or dormitory-style housing. The location of housing and offices is based on availability and convenience to the pipeline segment being constructed.

All work crews are trained in first-aid response and depend on local hospitals and clinics for professional medical services. Photo 2 (pg. 22) shows a typical first-aid station at the construction worksite. In many cases, two to six workers are assigned to each living quarter. Meals are provided either by staff cooks, hotel staff or contract services, or are catered by local restaurants. All workers must pass a physical before beginning employment. Kitchen workers must undergo periodic health checks to guard against the spread of infectious diseases such as hepatitis, typhoid and tuberculosis.

Worksites range from isolated desert locations to rural farm villages and mountainous terrain. Work is conducted 10 hours a day, seven days a week. When working in flat terrain, and given favorable weather and site location conditions, a single crew can complete about 30 welds a day. This allows the work to advance one kilometer every three days. Workers are bused from their living accommodations to the worksite each day. Commute times vary as the worksites progress along the right-of-way.

Welding machines, welding tractors, side boom tractors, excavators and skid-mounted storage sheds are secured and left at the worksite overnight. Each worksite and its equipment are under 24-hour surveillance by contractor-provided security guards. Workers are allowed a 10-day unpaid leave every three months.

SARS Prevention Preparation

The CST performed a risk assessment when the pervasiveness of SARS throughout mainland China became known in mid-March 2003. The primary risk to the project was a worker contracting SARS, then contaminating coworkers and/or exposing members of the public. A single incidence of the disease in one work crew would likely have caused the entire crew to be quarantined for a two-week assessment. Although replacement workers could be mobilized from other parts of the country, the time required to do so would impact cost and schedule; furthermore, those workers would be subject to the same quarantine restrictions. Another concern was that village residents would block access to the construction right-of-way to protect the village from exposure to outsiders.

As a result of these factors, exposure to SARS was a major health concern that had to be mitigated. Fully isolating workers was not feasible since the contractors depended on public facilities for housing, food and general supplies. In addition, the nature of the

work locations required them to conduct their normal duties in public places. On the positive side, the construction plan of specifying multiple small contractors to simultaneously build segments of the pipeline helped ensure that infection of one work crew would not likely impact another crew.

In light of these considerations, all project CST offices and contractors were instructed in early May to prepare and implement SARS prevention plans specific to their work activities and locations. These plans were reviewed and approved by CST to ensure adequacy.

SARS Prevention Plans

A template for a worksite SARS prevention plan was distributed along with the directive to make it site-specific. This approach ensured a minimum standard and allowed flexibility to meet location-specific needs. The typical plan features these elements:

1) **A team to lead the implementation.** This group is referred to as the SARS Prevention Leading Team; it is led by the worksite's SH&E director or supervisor and would include several members from throughout the organization, such as engineers, supervisors, SH&E personnel, and procurement and logistics representatives.

2) **Team roles and responsibilities.** Roles were delineated for the leader, common members and specialist members. Responsibilities included: plan rollout, communication of preventive measures, daily status reports, frequent contact with medical resources and acquisition/distribution of medical supplies.

3) **Health maintenance measures.**

- Promote knowledge and consciousness of SARS to all personnel.
- Provide available preventive/control measures.
- Maintain contact with health resource agencies.
- Monitor worker health daily.
- Maintain records.

4) **Classification of response levels.**

- Class A: SARS case found in the workforce but no successive case discovered within 15 days.
- Class B: SARS case found in the workforce and one successive case found.
- Class C: SARS case found in the workforce and two or more successive cases found.

5) **Response actions for the different classifications.** Response to each classification would involve varying degrees of these actions: a) transport individual to hospital; b) report situation to owner; c) cooperate with local authorities in response actions; d) disinfect accommodations; e) closely monitor the workforce for symptoms.

This template is based on basic risk mitigation techniques: identify risks; assign roles and responsibilities; specify practices and procedures to follow; classify and report incidents; establish response plans; and monitor workforce preparedness. This strategy is not unique to China and can be used for managing other situations posed by biological and epidemic threats.

Preventive Measures

According to many health resources, SARS is transmitted by close contact with a person who has the disease. Close contact means proximity that allows an individual to ingest another person's respiratory secretions or saliva. It can include living in the same room or household, providing care to the person, or having direct contact with respiratory secretions and other body fluids or fecal contamination from the infected person. This means it can be transmitted by face-to-face contact, through sneezing or coughing, and carried by aerosolized droplets. It may also be transmitted by contact with contaminated objects such as tissue, clothing, doorknobs, pencils, computer keyboards, tools, water and sewage. No inoculation is available to prevent the spread of SARS.

Given the known transmission mechanisms, the first line of defense in keeping workers healthy was awareness training. Medical professionals from local clinics or hospitals were brought in to describe SARS, its symptoms, identification methods, likely risk factors

Checking into a Hotel

Only designated hotels are authorized to house foreign guests. To check into these hotels, the foreign guest must complete a form; his/her passport and visa information is then recorded. This information is given to the police for their daily records. When SARS became an issue in Gansu province, some hotels simply shut their doors since business travel significantly declined. Those that remained open installed a medical check-in desk that had to be passed before approaching the registration desk. Upon entry, each guest registered his/her name, point of origin and next destination. This allowed authorities to notify those who happened to become exposed to an individual with SARS. During registration, the guest received a thermometer, and his/her temperature was recorded next to the name and itinerary plans. This information was sent to the local health department. A temperature above 38°C resulted in a visit to the hospital and, most likely, a two-week quarantine.

Some hotels required a daily temperature check for all foreign guests. Others required a much more extensive verification of a guest health. These hotels were typically located in areas where SARS cases were suspected; they required a doctor's certification stating that the person was SARS-free. This certification required a lung X-ray, blood test and medical check by a doctor at a local hospital. Some foreign travelers elected to undergo this testing for a one-time visit. However, many who visited many locations and hotels wanted to avoid subjecting themselves to this high frequency of X-rays and blood tests. If such a request was accompanied by evidence showing that the guest had resided in the province for several weeks, the hotel would relax its requirements and allow the guest to register as long as s/he provided daily body temperature readings.

Tips, Myths & Legends

Meals are an integral part of building relationships in China. It was common to be offered cigarettes and alcohol during each meal. At this point, an inside tip about SARS was commonly offered: No one who smoked had died from it, and those who didn't smoke were encouraged to reconsider. Surprisingly, no one suggested that the cleansing effects of drinking alcohol would prevent SARS. It was also commonly believed that raw garlic helped strengthen the immune system and fight SARS. Once the disease began to spread, garlic cloves were served at most lunches and dinners.

Spitting in public is endemic throughout China. Many government campaigns have been launched to eliminate this practice. Each side used SARS to its advantage. Government notices stated how spitting could spread SARS; in large cities, public spittoons and plastic spitting bags were provided. The campaigns are reportedly working in metropolitan areas. In rural areas along the pipeline construction route, however, folklore held that spitting helped eliminate the disease. The significantly fewer fatalities in the rural provinces served as the "scientific proof" for this myth.

Photo 1 (top): WEPP construction site.

Photo 2 (middle, left): First-aid station at WEPP worksite.

Photo 3 (middle, right): SARS checkpoint on Highway 312, near Jia Yu Guan, Gansu.

Photo 4 (bottom, left): SARS checkpoint at a farming village in Gansu in May 2003.

Photo 5 (bottom, right): Disinfecting vehicles at roadside SARS checkpoint on Highway 312.

and first response practices. Written and electronic literature was distributed to workers and discussed at regular safety meetings to ensure that all individuals understood the risks.

The second line of defense was to isolate workers from the public to the greatest extent possible. Examples of these measures:

- Entry gates or barriers, guards and signage were used to indicate that worksites and living quarters were not open to the general public. This included hotel floors occupied by contract personnel and other areas generally accessible by the public. Sign-in sheets and wash basins were provided for visitors' use. Some offices required that each visitor's temperature be recorded before entry was authorized.
- Meals were provided in a controlled environment rather than allowing workers to dine in public restaurants.
- Surgical-style facemasks were distributed to all workers along with instructions to wear the masks when in public areas.
- All workers were required to stay in their assigned living area and were discouraged from visiting public places. Some sites acquired additional entertainment equipment (e.g., TVs, DVD players, ping pong tables, pool tables) to make residences more accommodating.
- Relatives and friends were forbidden from visiting worker housing.
- Worker leave was suspended. The project owner agreed to accrue missed leave time so workers could use it when the epidemic passed or at the end of the project.
- Outdoor worksites were isolated from public access via flagging. All worksite visitors were required to sign in and have their body temperature recorded prior to entry to the worksite.
- All visitors and workers coming from cities where SARS cases had been confirmed were quarantined and monitored for two weeks before being allowed to mix with the local workforce. This requirement significantly reduced the number of visitors to the site and prevented workers from visiting areas where SARS had been confirmed.
- Planned periodic meetings and audits were assessed to eliminate all but those absolutely necessary face-to-face interactions. Overall, physical meetings were minimized to the extent possible. Use of e-mail, phone, fax and teleconferencing was encouraged to minimize exposure to the disease.

Measures were also taken to incorporate traditional Chinese medicine (TCM) to strengthen workers' immune systems. Herbal teas were distributed to all workers with instructions to drink the tea twice a day for two weeks. These packages were purchased from local pharmacies and distributed periodically; their contents were not specified.

In addition, workers were forbidden from taking medication other than that provided. This was meant to ensure proper, consistent medication. Literature on personal nutrition was distributed to encourage healthy diets and habits—and to discourage unhealthy habits common in Chinese culture, such as spitting in public and sharing of dishes when dining in a group. During this time, anecdotal evidence suggested that raw garlic helped the immune system fight SARS, so garlic was served at each meal.

Work areas were cleaned and disinfected with greater thoroughness. Cleaning staff was instructed to disinfect surfaces used by workers each day. Ventilation of indoor work areas was increased. Where applicable, heating and air conditioning systems were turned off and windows were opened to ensure that fresh air circulated throughout work areas. Fortunately, the coldest winter days were past and the heat of summer had not yet arrived.

Monitoring Methods

Monitoring individuals for SARS symptoms was a key tactic in early detection. Chinese laws enacted in April 2003 required all temporary residents in areas where SARS was suspected to register their temperature each day with local authorities. Since most of the construction contractors' employees were temporary residents, they were required to abide by this law. In most cases, this was done after dinner and reported to the police each morning.

The same practice was implemented at hotels. All guests of hotels in cities known to have suspected cases of SARS had their temperature taken each day

and reported to the local police. Any individual registering an abnormal temperature (greater than 38ºC) was reported to the local hospital. A hospital vehicle would then transport him/her to the hospital for observation in a quarantined ward, where s/he could expect a two-week stay since that was the expected virus incubation time. Temperatures were normally taken with a thermometer placed in the armpit for five minutes. In a few locations, electronic instruments that provide an immediate temperature reading were used.

In addition to monitoring by employers, public health agencies in the province established SARS monitoring stations along roadways entering and exiting cities with suspected SARS cases. This usually involved a roadblock or flag person to stop traffic and medical staff to record temperatures, names and travel plans. In addition to monitoring all passengers, a medical technician sprayed the inside of the vehicle with a disinfectant solution once occupants had exited (Photos 3, 4 and 5).

Most vehicles in this province are commercial and the traffic between cities is relatively light. Delays at most SARS checkpoints were rarely longer than 15 minutes. In some cases, secondary exits and entrances to cities were simply blocked with dirt piles and improvised barricades to prevent access from that point. These measures were primarily designed to keep out those who did not live in the immediate area. However, they also minimized all traffic; individuals who did not feel perfectly healthy or those who did not have an urgent need to be on the highway simply did not travel.

In addition to monitoring workers, SARS prevention measures were monitored. This was conducted at three levels. First, each organization was required to conduct a monthly self-assessment of its activities. To achieve this, each company completed a comprehensive review of operations, identified areas for improvement, completed appropriate corrective actions and reported findings to the local CST office. Second, the CST section office audited each contractor each month to verify conformance with requirements. These audits were completed using standardized checklists that addressed the full scope of the contractor's SH&E program and work activities. Third, the CST site office conducted monthly audits of each CST section office using a standardized scoring checklist that provided a tangible grade on performance. This grading showed areas of strengths and weaknesses and provided a mechanism to measure improvement.

Reporting Practices

Reporting of SARS-related statistics for the project began in mid-April and ended in late-June. This reporting scheme was defined by the owner and served to provide consistency throughout the six project sites. It was based on daily reports from each contractor to the local CST section office, which compiled the contractor-supplied data each day and reported it to the CST site offices. The site offices then compiled the section-supplied data each day and forwarded it to CST headquarters in Beijing. That office consolidated all site office data into a single report to the owner.

Daily reporting involved categorization of all project personnel—direct and indirect—as well as accounting of those in quarantine, those with SARS symptoms and those diagnosed by a doctor as having SARS. Additional input was requested in these reports to communicate the secondary impact of SARS on the construction project, such as training efforts, regional health situations, villages not allowing access, closed hotels, cancelled meetings and cooperation with government resources to contain the spread of SARS.

The Chinese Ministry of Health published daily reports to show the spread of SARS by province. Monitoring of this nationwide reporting of all mainland SARS cases—suspected, confirmed, recovered and deaths—served to quantify risks in the WEPP worksites in Gansu and Ningxia provinces. On the national level, the Ministry of Health established a SARS databank and reporting system to speed the identification of SARS and similar epidemics.

Challenges

Implementation of a western-style SH&E system in China is a significant challenge due to inherent cultural differences between East and West. The sidebar on pg. 19 offers several observations regarding cultural differences relevant to SH&E management systems.

During implementation of the SARS prevention plans, most cultural tendencies were overcome as a result of the following factors:

- Most WEPP contractors had been working with the SH&E management system for two years and had grown more comfortable with western approaches, such as risk classification, risk mitigation techniques, incident reporting, and detailed recordkeeping and information sharing between organizations.
- No variations from requirements were authorized. All personnel—from project leaders to common laborers—were required to comply with all measures. The example of compliance set by management strongly influenced the entire project.
- Chinese society is accustomed to following instructions from a central authority. (See "Visiting with the Locals" sidebar on pg. 20 and "Checking into a Hotel" on pg. 21.)
- Once the epidemic was acknowledged, the Chinese government set an excellent example by openly reporting all available information on SARS.
- Laws were passed that specified penalties for not complying with public measures designed to eliminate the disease.
- The urgency of the epidemic did not allow time for cultural sensitivity.
- SARS was characterized as a battle by the central government and all citizens were constantly encouraged on many fronts to help win the battle. Television, radio and newspapers presented a constant stream of communication to promote sacrifice of individual freedoms for the sake of the greater society. As a result

of this campaign, individuals sincerely wanted to demonstrate some level of personal sacrifice.

SH&E personnel faced other challenges in terms of managing the risk of SARS as well.

- Wide-ranging advice was available, but definitive medical information was lacking. (See "Tips, Myths & Legends" sidebar on pg. 21.)
- Complacency grew due to the fact that no SARS cases were being reported. Fortunately, the epidemic was over fairly quickly and mitigation measures were soon relaxed. This likely would not have been a factor had cases continued to be observed.
- Medical supplies were generally plentiful, with the exception of glass thermometers. Few rapid-reading, noncontact infrared thermometers were available. Costs of supplies increased due to high demand during April and May, but the government imposed strict controls on production and pricing. Availability of all supplies returned to normal in June.
- The axillary (armpit) method of measuring temperature was the most commonly used despite being considered the least accurate method for determining body temperature. Unfortunately, due to cost and availability considerations, it was often the only choice.

Results & Conclusions

Implementation of the SARS prevention plans had a significant, but difficult to quantify, impact on the workforce. Significant focus was placed on training, but this training usually occurred during scheduled safety meetings—it simply displaced less-critical topics. No indicators suggest that worker productivity suffered due to the preventive measures. In one sense, field worker productivity actually improved because fewer worksite audits and site visits were conducted by outsiders.

The measures that produced the greatest impact were administrative in nature—collecting temperature data and preparing daily reports. While no staff positions were added to handle this paperwork, existing staff expended significant time and effort to ensure that reports were accurate and submitted on time. Although additional costs were incurred for TCM, training, quarantines and SARS-specific supplies, these costs were offset by the savings realized due to lower travel expenditures.

Formal reporting of the SARS risk management activities began in late April and ended in late June after no new SARS cases had been identified for 15 days. It is worth noting that no new cases have been identified since that time, supporting this decision. Since initiation in late April, the reports evolved and increased in length and complexity until the time they were terminated. In the end, daily reporting of SARS activity for Site 2 was a significant administrative task due to the large number of people (4,600) working on the site.

Records show that no suspected or actual cases of SARS were observed among the workforce. A total of 15 people were quarantined because they came from areas with confirmed SARS cases. This means that no elevated temperature or other obvious SARS symptoms were observed among any of the 4,600 people monitored during that two-month period. It should be noted that during this epidemic, only two fatalities were reported in the Gansu and Ningxia provinces (which have a combined population of 30 million).

From a practical standpoint, the SARS epidemic was essentially over in Gansu province soon after significant efforts were implemented to guard against it. The comprehensive preventive measures implemented largely alerted workers that they needed to monitor their health and take practical measures to safeguard it. The effectiveness of the measures implemented was not tested since no worker ever exhibited SARS symptoms. However, the lack of cases is viewed as evidence of the effectiveness of the approach.

This experience is best viewed as an exercise in preparedness. Mainland China has progressed along the learning curve in terms of early identification and control of a highly contagious disease. The lessons learned by the Chinese government in openly reporting the spread of diseases that present significant risks to the public ensure that a similar problem will be identified much sooner in the future.

In the specific case of WEPP, the project now has effective plans that can be quickly implemented to manage the risks of SARS should the disease return. Basic health practices to avoid contracting common contagious diseases are now a regular safety meeting topic. People are now trained in SARS prevention plans and readily understand how to implement these plans should the need arise. Reaction time has been improved significantly since spring 2003. SARS may return, but this project is well-prepared to respond in an effective, timely manner. ■

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