PANAMA CANAL EXPANSION PROGRAM

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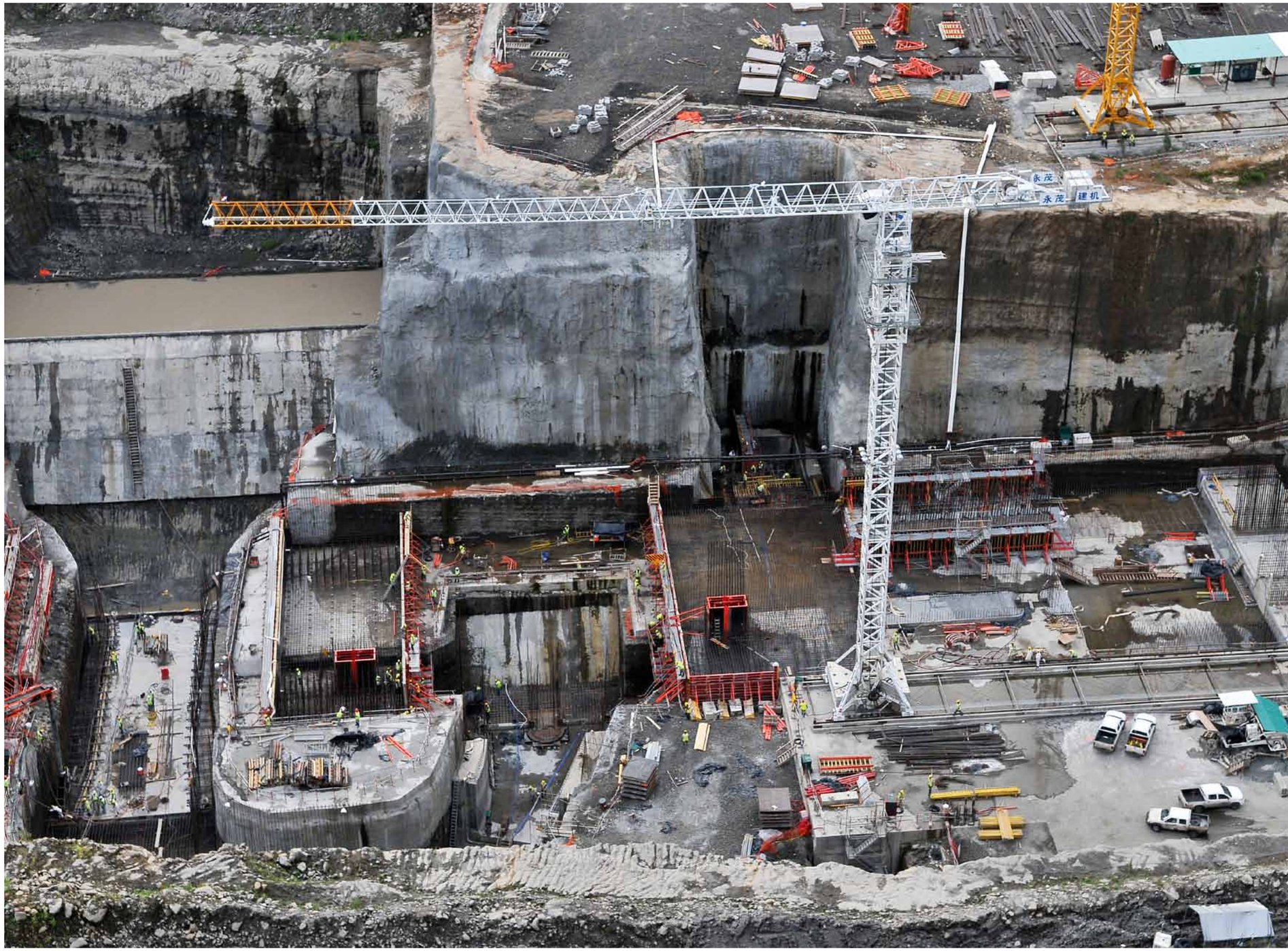
A MODERN WONDER

Jorge Quijano, executive vice president of engineering with the Panama Canal Authority (ACP), talks to Jayne Alverca about taking Central America's most high profile infrastructure program from concept to completion

Owing to a unique strategic location that dissects the American continent to connect the Atlantic and Pacific Oceans, the Panama Canal has had a transformative effect on world maritime commerce. Many of the patterns of international trade that shape the contemporary global economy owe their existence to this very special waterway. From a national perspective, the canal is even more important. It contributes around 20 percent of Panama's GDP and is intrinsically linked to Panamanian national identity and pride as well as the country's aspirations for economic growth.

The canal's origins are rooted in a distant colonial past. The French first attempted to link the two oceans at the turn of the 20th century but were defeated by the malaria and yellow fever, the heavy rainfalls typical of the tropical rainforest, and financial woes. It was left to the US to complete construction of the first two-lane canal and the initial set of locks which became operational in 1914. On the eve of the Second World War, the Americans attempted to build a second set of locks which would allow the transit of larger commercial vessels and war ships. The work was started in 1939 but aborted as a consequence of World War II and the canal has since had no quantum upgrades.

Since 1999, when the US finally ceded control of the canal to the Republic of Panama, the Panama Canal Authority (ACP), which operates as an autonomous agency of the Government of Panama, has had the task of managing this vital



Ongoing construction of the water saving basins' conduits in the chamber floor of the new Atlantic Lock

commercial waterway.

As the canal moves towards celebrating the 100th anniversary of its inauguration, ACP marches on its spectacular program of works which will double the canal's capacity and enable it to accommodate the new generation of super container vessels. By allowing larger vessels and increasing capacity, the expansion program will open the canal to new routes and previously untapped markets. During the next 20 years, it is estimated that cargo volumes moving through the canal will grow an average of three percent per annum, almost doubling the tonnage of 2005 by 2025. If maritime trade continues to accelerate after the recession, that figure could increase significantly.

The program of works currently being undertaken is Central America's most visible expansion program and the largest project in the canal's history to date. Seventy years after the last major improvement project was first undertaken and then aborted, a third set of locks is soon to be added as part of a $5.25 billion expansion program. But this time it is home-grown Panamanian

Basalt excavation of the access channel that will connect the new Pacific Lock to Gatun lake at Culebra Cut

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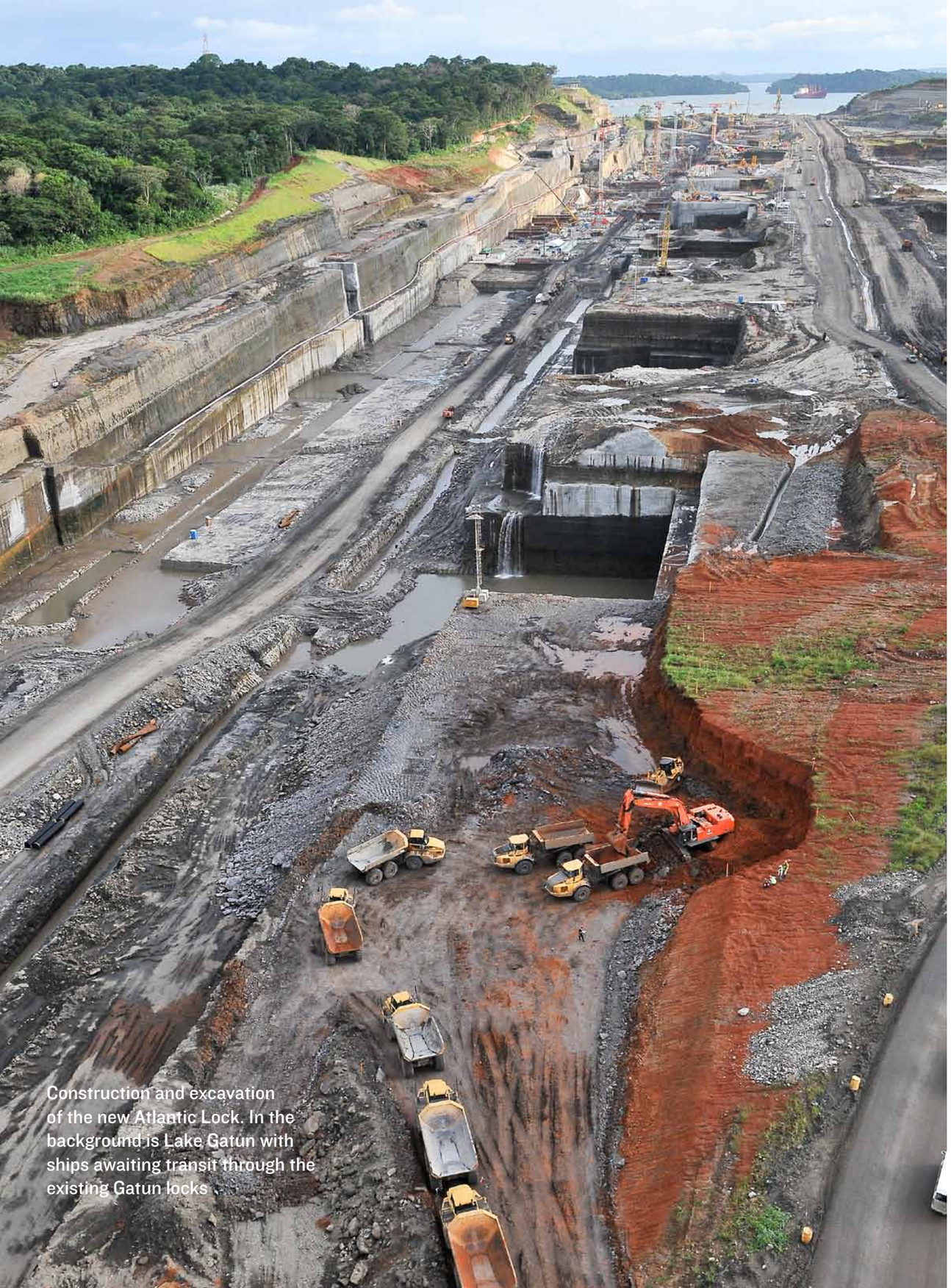

Construction and excavation of the new Atlantic Lock. In the background is Lake Gatun with ships awaiting transit through the existing Gatun locks

engineering and management talent which is in the spotlight.

The existing two sets of locks, which raise ships 85 feet above sea level, have so far defined the "Panamax" standard, which limits the size of container vessels to a maximum of 5,000 TEU (twenty-foot equivalent units). From 2014, deeper and wider access channels will complement new locks to the southwest of the existing Miraflores Locks on the Pacific side and east of Gatun Locks on the Atlantic side. This will enable the canal to move into the "post-Panamax" phase of its evolution and accommodate the transit of 13,000+ TEU ships.

13,000 TEU:

Post-Panamax capacity when project complete

NATIONAL DECISION

The decision to expand the canal was judged to be of such critical importance to Panama's future that it was the subject of a national referendum in 2006 when all citizens were invited to make their views known. At the time, President Martín Torrijos Espino said it was the most important decision his generation had to take. Public approval was readily evident when over 76 percent of voters declared they were in favor of the expansion.

A year later, Torrijos Espino announced the Cabinet Council's authorization for the Panama Canal Authority (ACP) to negotiate the financial support package required. Since then a group of multilateral and bilateral credit organizations, including the European Investment Bank, the Japan Bank for International Cooperation, the Inter-American Development Bank, International Financial Corporation and the Andean Development Corporation have pledged a total of $2,300 million.

Jorge Quijano is executive vice president of engineering with responsibility for the expansion program and is tasked with transforming this vision into reality. He was formally assigned to the role in 2007 after taking a lead on the program a year earlier following the positive vote in the referendum.

"This is the most visible program in the region. It may not be the largest when you consider what is being spent on the infrastructure improvements that are taking place in countries like Brazil, but the Panama Canal Expansion Program will have an extremely far-reaching international impact through the creation of new routes and the opening of new markets," he says.

KEY CONTRACTS

On 15 July, 2009, it was announced that Grupo Unidos por el Canal SA (GUPCSA) had been granted the job of designing and building the two new sets of locks that will join the Panama Canal to the Atlantic Ocean at one end and the Pacific Ocean at the other. GUPCSA is a consortium comprising Sacyr Vallehermoso SA of Spain, Impregilo SpA of Italy, dredging specialist Jan De Nul NV of the Netherlands, and the

Panamanian construction company, CUSA.

There was fierce competition for this project, worth $3.2 billion. Four international consortia were prequalified and in the end three bid for the project. ACP evaluated the proposals and judged that GUPC presented the best value proposition and had the resources to execute the locks project and bring it to completion by the scheduled date in late October 2014, in the year of the centenary of the canal's opening. Meanwhile, Dredging International was awarded the contract for deepening and widening the Pacific entrance channel and Jan de Nul would undertake dredging of the Atlantic entrance channel.

The expansion program also involves building a new channel - the Pacific Access Channel - that bypasses Miraflores Lake in parallel to the existing channel and locks. This new channel measures 6.1 kilometers and has been awarded via four distinct contracts. CUSA, a local contractor, won the initial excavation contract in 2007. Then a second dry excavation contract was undertaken by the Mexican-Panamanian

Excavation has been split into four contracts

"THE EXPANSION PROGRAM ALSO INVOLVES BUILDING THE PACIFIC ACCESS CHANNEL THAT BYPASSES MIRAFLORES LAKE IN PARALLEL TO THE EXISTING CHANNEL AND LOCKS"

Construction of cement bentonite slurry wall between the northern end of the access channel to the new Pacific Lock and the exiting Pedro Miguel Locks

consortium Cilsa Panama-Minera Maria. A third contract was awarded in 2008 to Constructora Meco SA, for a total of $36.6 million. All of these works have now been completed.

The last dry excavation project, which is ongoing, is the most expensive and challenging and has been awarded to the Mexican, Spanish and Costa Rican joint venture ICA-FCC-MECO. This project, known as PAC 4, is worth a total of $267,798,795 and is the second largest and most complex project after the new locks. It covers a key portion of the expansion's new access channel linking the new Pacific locks with Culebra Cut, the narrowest stretch of the Panama Canal.

These are the main contracted projects, Quijano explains, although at the mouth of the Pacific Access Channel, there is also another small but significant dredging project that Jan de Nul is undertaking which should be completed by mid-year.

His rationale for splitting the excavation of the 6.1 km channel into four contracts is clear. "By designing these projects in discrete elements, it meant we could do the entire excavation program in eight years. We would not have been able to do a full design for the entire length of the channel for another two years which would have meant two years of lost time. Another consideration was that we wanted to start with smaller projects to give local and regional contractors an opportunity to participate. They were able to come up with very good bid prices and as a result we have some components that were completed well under budget.

New Pacific Lock construction looking north. In the background is Miraflores lake and the hills that conform the continental divide

"Working closely with the contractors has also given us many opportunities for a shared approach to value engineering. For example, the completion of the first phase of the excavation work was achieved with a saving of $700,000 for ACP and the contractor improved its profit margin more than they anticipated by providing the ACP with a redesign of a portion of a road. It has been a similar success story with all three of the first dry excavation projects which have all come in under budget."

These savings are then transferred into a global contingency fund which can be used on project components that need additional resourcing. Nature and geology are a potent mix and no outcome is totally predictable, but so far most projects have been completed on time and within budget. However, the most critical and expensive phases of the project are those which are

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Construction continues day and night at the new Atlantic Lock site

now underway and he envisages that more resources may be required, especially in completing the channel that connects the new Pacific locks to the Culebra cut and bringing the locks project to completion on time. “We started with a large contingency fund containing over $1.5 billion dollars to account for inflation and all sorts of possible unknowns in the field. As projects were designed, bidded and awarded at or under budget the remaining contingencies have been consolidated to complement the final components of the expansion if we see that they are needed,” he adds.

RISK MITIGATION

Quijano is keen to point out that all of the work, with the exception of the locks, has been designed in-house by ACP engineers and complemented with consultants for the dams. Design also entails full responsibility for extensive preliminary geological investigations. “Most litigation claims normally arise from problems and errors related to few and inadequate geological information, so we did a great deal of legwork before we put these projects out to tender,” he explains.

> “I BELIEVE THAT EVERY DOLLAR INVESTED AT THE PLANNING AND PREPARATORY STAGE IS WORTH THREE TO FIVE DOLLARS LATER ON”

20 MILLION:

Cubic meters of dredging at Gatun Lake

Understanding the nature of risk and transferring its ownership has been a critical issue. Even on projects of this scale, there is sometimes only a small window of opportunity to make preparations. But he makes it clear that this has not been the case with the Panama Canal Expansion Program. “To get it right in project management, you have to take the time to prepare properly. I believe that every dollar invested at the planning and preparatory stage is worth three to five dollars later on. We have been studying ways to expand the Canal since 1997 and looking at alternatives and options. Then in 2002 and 2003, we invited other consultants to particularly contribute on the locks project to find a way to avoid building an additional reservoir. This further mitigated the risk and limited the contingencies we had to consider,” he says.

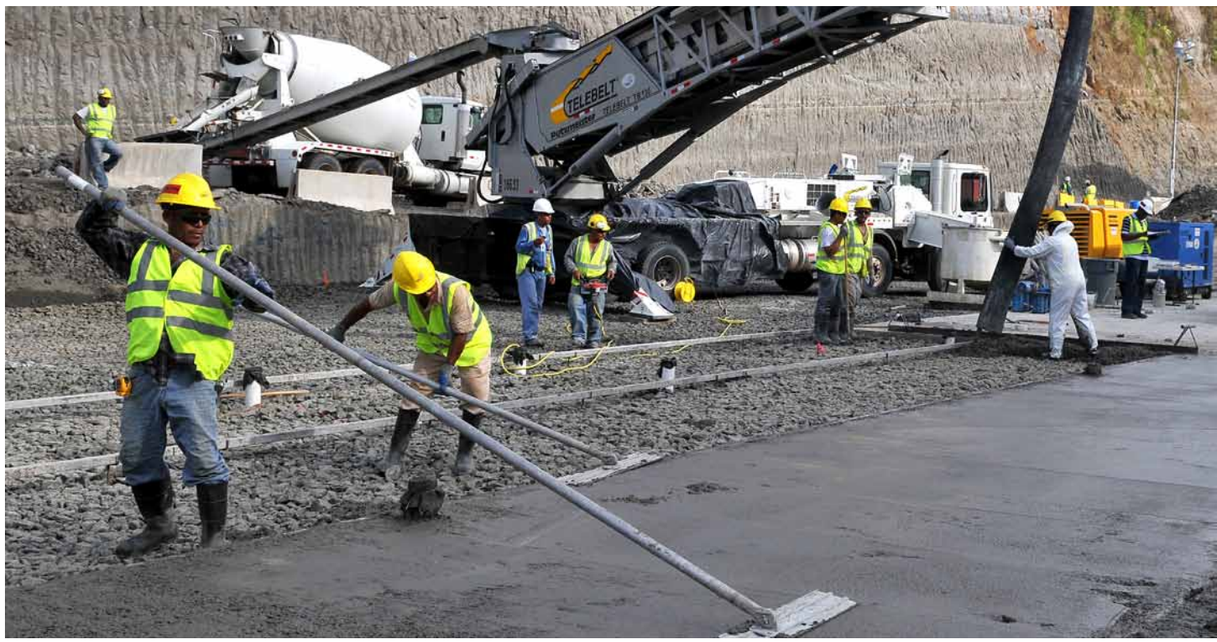
“Each contract presents a different

risk profile," he continues. "On the dry excavation side for example, we have been contracting work out for more than twenty years and each time it has been on the basis of presenting contractors with tenders that required excavations of unclassified material. We know the geology of the area very well by now and in our tenders we make available all of the information to the interested bidders. All bidding contractors are shown the registers of what we have found and we tell them exactly where such cores were taken from. We have cores which have been taken along the entire length of the proposed work. In this way we can transfer most of the risk, but this approach also limits the risk taken on by those who want to work with us."

For the core locks project though, which has a value of $3.2 billion, a different approach was taken. "This element we decided not to tackle ourselves. It was decided that it would be delivered through a design-build contract. As such the whole design risk has been effectively transferred to Montgomery Watson Harza who the consortium has chosen to be the designer of record for the locks. These locks are being built entirely according to their design and specifications, although of course we have reviewed the process closely."

> "WE HAVE CORES WHICH HAVE BEEN TAKEN ALONG THE ENTIRE LENGTH OF THE PROPOSED WORK"

Drilling of Gatun Formation to install rock anchors



Leveling concrete base being placed so that forms and rebar can be installed effectively over it, and structural marine concrete can later be poured

Quijano is responsible for an internal team which numbers over 500 people, of which 200 are responsible for engineering support and 300 manage the projects in the field for the ACP. Another 800+ of operations personnel are assigned to perform the Gatun Lake area dredging where 20 million cubic meters of dredging is being directly undertaken by ACP. Gatun Lake has an area of 164 square miles(425 km2) when its surface is at a normal elevation of 85 feet (25.9 m) above sea level, which made it the largest artificially formed lake in the world in 1914.

In addition to the dredging project that will allow additional draft for the vessels that will transit the new locks there is another project that will increase Gatun Lake's maximum operating level by 45 centimeters, from its current 26.7 meters to 27.1 meters and will provide additional storage capacity for more than 200 million cubic meters of water in the lake. This project also adds to the draft reliability of the lake.

The lake is a particularly sensitive area

Excavation of access channel that connects the new Pacific Lock to the Culebra Cut

> "WE TAKE INTO ACCOUNT ALL POSSIBLE ISSUES AND CONTINGENCIES BEFORE WE MAKE CRITICAL DECISIONS"

because this is where traffic is most restricted and it has been a priority that the canal should continue to operate as efficiently as ever while works are in progress. "We decided that because transiting vessels in the lake move regularly past the equipment, the dredging work would be best left to our internal team which has 100 years of navigational dredging expertise in the area. Nonetheless the northern sections of the lake's channels are wider, with fewer safety and operational implications, so these have been contracted out," he explains.

MANAGING COMPLEXITY

At the outset, Quijano adopted the Project Management Institute's operational framework across every element of the proposed program of work. "It represents a very structured way of managing projects by establishing a clear resource loaded baseline to follow at the outset, but also allows us to look at ways of leveraging value variations. All changes are very strictly controlled and we address possible change orders very carefully long before they actually occur by testing out all risks, impacts and possible scenarios. This approach enables us to take into account all possible issues and contingencies before we make critical decisions, such as whether we should contract out a certain component, or obtain coverage for fuel price escalations."

He also attaches much importance to having the right organizational structure in place. "It is not just about having talented people. In some areas management ability may be more important than technical skills and we have to get the right balance every time. Here we took a very novel approach to maximizing our own internal engineering talent and local knowledge with the best international consultants in project management to boost our knowhow in some specific areas," he says.

In 2007, ACP contracted CH2MHill, known for their project management of the London Olympics, to support the expansion program for the rest of its duration. "Most of their effort is concentrated on the locks, which is the most complex aspect of the expansion, but at a program management level many other projects feed into this overall objective and we looked for external support to get the integration we felt we needed," he explains.

Shaping the north channel entrance banks to the new Atlantic locks

He goes on to point out that this mixed integrated management approach led to some idiosyncrasies at the outset, but with adjustment on both sides, there is now a combined effort which has created a seamless working environment. “We did not want a turnkey approach to this project because we have many highly skilled and capable engineers within ACP. It was more a question of filling in the knowledge and experience gaps and now, after four years of working with CH2MHill, we are all perfectly aligned with objectives that are understood and shared across the program. I feel we have succeeded in mixing the best of local talent with the expertise of some of the finest international consultants to achieve an extraordinary feat of engineering,” he comments.

For Quijano and his team there is no greater buzz than stepping outside and seeing the results of geology twinned with the best technology when the new channels operate exactly as they should. Everyone involved in the program, he adds, feels they are working towards a historic moment when the new locks will open to oceangoing vessels less than 3 years from now. GUPCSA was given 1,883 days to fulfill its contract and the clock is ticking. By the end of 2013, only the final completion and placing of the locks in service should be outstanding. BE

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