THE DEMOLITION OF A **130,000 CUBIC METRE** TANK'S FLOATING ROOF.

THE TECHNICAL METHODS AND COMBINED SKILLS USED IN THIS DEMOLITION AND RECLAMATION PROJECT RESULTED IN THE COMPLETION OF A LARGE-SCALE OPERATION, GUARANTEEING HIGH STANDARDS OF **SAFETY** AND **ENVIRONMENTAL PROTECTION**

*by Ivan Poroli**

In the summer of 2009, Montalbetti S.p.A. was called to face a considerable challenge: a demolition and reclamation project that had to be undertaken in particularly difficult conditions.

One of Italy's biggest oil refineries had asked for the demolition and reclamation of the floating roof of a large tank: an operation that may have seemed banal on paper, but on visiting the site, the difficulties to be tackled became immediately apparent.

The work involved a floating roof tank with a total capacity of 130,000 cubic metres, an extremely large metal structure of around 93 metres in diameter by 22 metres in height. The floating roof was metal and made up of watertight compartments of around 80-100 cm in height, radiating out from the centre. The function of these sealed compartments is to ensure that the roof floats on top of the liquid, sinking and rising with the level when the tank is filled. When the tank is emptied, the roof moves down the tank until it comes to rest on a number of pins, similar to props (called support legs) that keep it around 2 metres above the bottom and which allow maintenance and cleaning work to be done.

The tank in question had originally been designed to hold crude oil, but during its working life it had been 'downgraded' and was used to contain slop and bilge residues. During our inspection of the site, we immediately ascertained that due to the highly corrosive properties of the materials contained inside (especially crude oil with high levels of sulphur), many compartments had lost their watertight properties and liquid had seeped inside. When the tank was emptied, the floating roof, weighed down by the

liquid in the compartments, had become

unbalanced. Once the support legs reached the bottom, they crippled under the excessive weight. As the roof collapsed from the pressure below, it had practically come to rest on the floor of the tank.

The situation we witnessed was that of a structure whose existing conditions would not allow access, in that the floating roof had been classified as dangerous due to the precarious state of the sheet metal and the supports.
No reclamation work would be possible in these conditions without demolishing the floating roof first.

It was necessary to demolish the roof so as to allow access both to the contaminated compartments as well as the gap, only a few centimetres wide, between the bottom of the tank and the floating roof, in order to remove residual material and clean the floor and sides of the tank.
The material in the tank was partly liquid enough to be pumped away and partly semi-solid which was more difficult to handle. The metal smeared with this material needed to be carefully cleaned with water at high pressure in order to guarantee the elimination of contaminating residues.

Therefore the work had to be carried out in close cooperation with a company specialising in reclamation, providing avantgarde equipment and setting up the right systems and synergies which would be necessary to reach our goal, and also guarantee safety and environmental conditions of the highest level.

During the planning phase, the main critical factors involved were analysed and these can be summarised as follows:

- how to handle the quantity and type of material to be removed;
- the mitigation of the effects on the external environment (lowering the level of fumes);
- the difficult working environment for our staff;
- keeping the risk of explosive gases under control;
- rapid working time;
- avoiding the risk of overlapping operations.

Working closely with the reclamation company, we perfected a series of procedures and technical/operative preparations necessary to control the critical factors that had come to light during the planning stage.

We decided to use a mechanical system of demolition, done with a special digger equipped with hydraulic shears: it was felt that this technique was the best compromise between working speed and guaranteed safety for workers (with the addition of special safety and prevention measures).
Before starting the demolition work, the company hired to carry out the reclamation procedure built a structure perched at the top of the tank, made of flexible pipes and spray nozzles, designed to release anti-odour substances which would reduce the fumes created when moving materials.

In the second phase, an initial drainage of the water inside the tank was done using the valves on the bottom and the hatches that were accessible. The accumulation of water in the tank had been caused by heavy rainfall during these operations. Next, we went on to remove the liquid material which was easy to pump out, by installing a system of pumps and filters in various accessible parts of the tank. In order to guarantee that demolition equipment (the digger equipped with hydraulic shears) could gain access to the inside of the tank and be able to remove scrap metal, we had to create a 4 x 4 metre hole using cold cutting high pressure water jets.
The hole was drilled at a height of around 40 cm from the bottom to guarantee an adequate 'ledge' or the material inside would have leaked out of the tank.

Access for the digger was later improved by building a ramp out of inert materials, made to the correct size and reinforced.

The use of cold cutting techniques proved to be essential in that – especially during this working phase – it was wise to avoid any source of ignition, given that the explosive conditions inside the tank were not easy to assess, due to the lack of safe access to the floating roof.
Once an adequate hole was created, it was possible to collect precise information on the conditions of explosiveness inside the first compartments, as well as in the small gap between the floating roof and the floor of the tank.
The measurements gathered provided encouraging data: the evaporation of lighter materials over the years, the later use of the tank to collect heavy materials and the addition of rainfall had almost

completely removed any vapours on the surface of the material at the tank's operating temperature (room temperature). Nevertheless, in order to keep the risk of ignition under control and so as to monitor the situation, we decided to use the following safety systems:

- the digger was equipped with rubber track pads to reduce the amount of friction against the steel floor of the tank and consequently the possible increase in temperature or creation of sparks;
- a 'nose' was fitted near the tool (the hydraulic shears), equipped to specifically sense fumes created by the material inside the tank. As well as continually registering the percentage of fumes in the area, it would set off a siren and light up should the percentage of fumes reach the limit of explosiveness, which would immediately result in the shutting off of the digger and the disconnection of the battery;
- an alphanumeric display placed inside the digger's cabin and connected to the 'nose' supplied the driver with continual updates on the percentage of gases present near the working area of the shears;
- a further safety system was installed to avoid explosive environments and fire hazards, made up of jets properly positioned near the working area that could continually sprinkle water on the place where the digger's shears were operating;
- in addition, a foam extinguishing system was placed on the top of the tank for extreme emergency conditions.

Work on demolishing the floating roof began on the 1st of October 2009 with the removal of the first compartments near the skin opening. Then, working closely with the reclamation company, we went on to remove the semi-solid materials, to demolish the roof and clean the scrap metal using high pressure jets.

During the entire duration of this operation – and thanks to the skill of the workers involved – we were able to proceed with the demolition at a constant pace, guaranteeing furthermore that the size of demolished materials would be appropriate for their subsequent cleaning outside of the tank, in a properly equipped purpose-built vat. In order to be able to guarantee continuity from one phase of work to another it was necessary to coordinate precisely all activities, including those of reclamation and the cleaning of scrap metal resulting from the demolition. For this reason, it became appropriate to establish both the size and shape of the scrap metal pieces, in order to allow easy handling and access to all surfaces that required high pressure cleaning.

The presence of heavy material that could not be pumped out of the tank without a special treatment beforehand made the digger's movements inside the tank awkward, in that this material sometimes reached a metre in height, covering the caterpillar tracks.

Only with the combined action of demolishing and then removing materials with small rubber spades was it possible to continue the demolition, making the parts of the floating roof that needed demolishing accessible.

The mechanical demolition phase was

completed in 45 days while the reclamation and cleaning phase continued for another 20 days. The speed of the work carried out, the low environmental impact and the proper safety levels maintained during the entire course of the operation proved the value of the project and the high technical and professional level of the staff that participated.

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* *Montalbetti S.p. a.*