

Case History on Defined Sump Floating Cover System, MWD Southern California, Skinner Water Treatment Plant

Brian W. Fraser, MBA, Layfield Group Limited, Edmonton, Alberta, Canada
Mike P. Neal, Layfield Environmental Systems Inc., San Diego, California, USA
Hans J. Vandenberg, P.E., Metropolitan Water District of Southern California, USA

THIS PAPER WAS ORIGINALLY PRESENTED AT THE 2011 GEOSYNTHETICS CONFERENCE | DALLAS, TX, USA

ABSTRACT

As part of a potable water reservoir project for the Metropolitan Water District of Southern California, Layfield Environmental Systems fabricated and installed a flexible geomembrane defined sump floating cover system. On this project Layfield operated as the general contractor with a scope of work that included removing and replacing the existing floating cover and installing a new 65,000 m² (700,000 ft²) floating cover system. The project also included an additional 28,000 m² (300,000 ft²) of a chafer reinforcement material around the perimeter of the floating cover, rain water removal pumps, upgrading of the existing electrical systems, installation of drain pipes, mechanical work and the design and operation of a temporary water treatment facility.

This project encountered some serious installation challenges including a tight 180-day installation schedule as this was a critical reservoir with an operational capacity of 130.4 hectares (326-acre feet) providing treated water to Riverside and San Diego Counties. A special consideration on this project was the requirement to capture all water that was collected from the construction site. This included the design and operation of a temporary water treatment facility as the Regional Water Quality Board had set strict discharge limits on the water released from the site. The water treatment plant was designed to capture nuisance chemicals or contaminants in rainwater as a result of construction.

There was also major water leakage of up to 1,135 litres (300 gallons) per minute at the influent and effluent gates requiring continuous pumping and dewatering strategies throughout the duration of the project. The project was further challenged by excessive poor weather as part of an El Nino year in California. This paper discusses the various technical challenges and the innovative design and project management solutions incorporated to help finish the project on schedule.

INTRODUCTION

In July 2009 the Metropolitan Water District of Southern California (Owner) awarded Layfield Environmental Systems Corporation (General Contractor) the contract to supply and install a new floating cover system for the Robert A. Skinner Water Treatment Plant in Winchester, California. This water treatment plant was a critical single finished water reservoir for the water district. Water treatment fluctuations are normally buffered by alternative reservoirs, which were not available during the timeline

For up-to-date technical information, be sure to visit us online at www.LayfieldGeo.com

of this project. The scope of work included decommissioning the older geomembrane floating cover system and supplying and installing a new 65,000 m² (700,000 ft²) floating cover system including various electrical, mechanical and concrete restoration work. As the asphalt base was in poor condition a special 30.5 metre (100 foot) reinforced chafer strip was required directly underneath the floating cover located on the slope. The chafer strip was designed to prevent abrasion of the primary floating cover material and was mechanically attached around the full perimeter to the main concrete berm anchorage system. The decommissioning of the old liner system and installation of the new liner system included approximately 1,036.3 metre (3,400 lineal feet) of mechanical attachment to the concrete anchorage system in accordance with the Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures (ASTM D6497). The existing geomembrane cover system was over 20 years old and showing some signs of material fatigue and damage. The owner had growing concerns related to safety issues as the cover system required both planned and unplanned maintenance requiring personnel to work on top of the cover while the system was in operation. This was one of the main factors in the owners' decision to replace the existing floating cover system.



Figure 1: Overview of Floating Cover



Figure 2: Chafer Strip & CSPE Cover

The floating cover system incorporated a defined sump design closely following the AWWA California-Nevada Section Reservoir Floating Cover Guidelines. Hilt Consulting Group, Inc. from Chino, California provided the design of the floating cover system. Further to the AWWA CA/NV guidelines the owner requested additional design features including additional secondary rainwater removal suction hoses. The primary rainwater removal pumps also required further design precautions to prevent the pumps from pumping dry. These included a flow meter at the top of the slope with input being fed back in the control panel. The owner also required a special tan top ply color for the floating cover material which better matched existing site requirements.



Figure 3: Defined Sump Design



Figure 4: Installation of Pipe System

The new geomembrane floating cover material used was Hypalon® Chlorosulphonated Polyethylene (CSPE). The geomembrane needed to be potable water compliant and meet the National Sanitation Foundation NSF/ANSI Standard 61 Drinking Water System Components (NSF/ANSI Standard 61). The geomembrane also required adequate long-term resistance to chlorine used as a disinfectant in accordance with AWWA Standard for Disinfection of Water Storage Facilities (ANSI/AWWA C652 Method #3). The geomembrane cover material also required very good long term ultraviolet light resistance as the cover system was designed for a 20 plus year service life. Construction activities started on December 1, 2009, and the project was completed on March 15, 2010. Official notice of completion was filed on April 1, 2010.

PROJECT CHALLENGES

The project faced a number of operational, design and construction challenges. One of the main operational challenges was with the construction schedule. As this was the water districts' single finished water reservoir with 130.4 hectares (326-acre feet) of capacity servicing the Riverside and San Diego Counties it was critical that project was completed during non-peak demand season. To address the tight time constraints the floating cover material was prefabricated in the contractor's geomembrane fabrication plant in El Cajon, California facility prior to the water reservoir being taken out of service. The prefabrication technique included producing 10.36 meter (34') wide fabricated panels without any accordion folds in the panels as folding of any kind of the main floating cover material was not allowed in accordance with the project specification. This prefabrication requirement reduced workmanship issues commonly associated with field wrinkles and enhanced field panel deployment, welding times and overall quality. A special 75 mm (3") wide wedge was used for all factory and field welding of the geomembrane. This wider than normal 75 mm (3") wedge welding technique provided increased tensile strengths in the seam and a fully welded top and bottom seam with no loose edges. The wedge welding further reduced the need for chemical solvent welding which enhanced installation speed and quality. Both hot air welding and a specific CSPE adhesive were used in the field to fabricate pipe boots and custom fittings for hatches, walkways and various other cover appurtenances. All field or factory cut edges which had an exposed fabric scrim were flood coated with the adhesive to fully encapsulate the scrim. At regular scheduled intervals throughout the workday, peel and shear testing was performed on all factory and field welds. To confirm overall welded seam integrity, all factory and field seams were further tested and then air lance tested following the guidelines of Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes (ASTM D4437-08). The total cover was further inspected by inflating in sequence specific sections for visual inspections of holes and defects.



Figure 5: Fabrication of Sump Floats



Figure 6: Mechanical Anchorage Detail

A second key project challenge was the requirement to capture, treat and discharge all water that was collected from the construction site. The water sources included normal rainwater and flush water used during the start up and testing procedures. This challenge required the design, construction and operation of a temporary water treatment facility as the Regional Water Quality Board had set strict discharge limits on the water released from the site. This process required a peak design capacity of 1,325 liters (350 gallons) per minute. The equipment included submersible dewatering pumps, piping systems, 30,200-liter (8,000 gallon) Weir holding tank, a bag filter system for sediment removal and two 2,268 Kg (5,000 lb) carbon vessels to remove any residual volatile organic compounds. Random and scheduled independent third-party testing was conducted on the effluent to ensure it was within the strict discharge limited. A final flow meter with totalizer function was installed in-line just upstream of the catch basin to record actual discharge flow rates and the total volume discharged over the construction period. The water treatment plant was designed to capture all nuisance chemicals, contaminants and sediment in rainwater as a result of construction. The general contractor's scope of work included the construction and decommissioning of the temporary water treatment plant. The water treatment plant was then decommissioned shortly after the facility was operational and final tests verified satisfactory discharge levels. During construction approximately 15.1 million liters (7.5 million gallons) of surface rainwater were treated and discharged through the temporary water treatment plant.

A final and unexpected project challenge came from water infiltration problems as a result of leaks at the influent and effluent reservoir gates and unexpected heavy rains. Major water leakage at the pipe gates up to 1,335 litres (300 gallons) per minute required special dewatering strategies. These included the construction of portable coffer dams that allowed the potable water to be captured and accumulated prior to being pumped back into the main water districts treatment facility. Special back up pumps were also required. Water infiltration problems were further compounded by heavy rain storms as a result of an El Nino year caused construction delays and required major site dewatering strategies. The portable coffer dams were also used to separate all accumulations of rain water from the potable water leaking from the pipe gates. All accumulations of rain water had to be treated through the temporary water treatment plant. The combination of heavy rain events and the high volume of water leaking from the pipe gates created a number of challenges throughout the duration of the project.



Figure 7: Water Treatment Plant



Figure 8: Water Infiltration & Dewatering requirements

CONCLUSION

On March 15, 2010, this project was completed on time and on budget. This floating cover project included a number of difficult challenges that added complexities and time constraints to an already challenging project. The success of this project is credited to the professionalism of the owner; quality of the design services provided by the consultants and construction and project management skills and experience of the contractor. The project also benefited from excellent communications and cooperation from all parties to resolve unexpected and problems and work together to stay on schedule. Without the teamwork of the owner and design engineers in conjunction with the contractors' team, this highly difficult project would not have been

completed on time or delivered the high quality floating cover system with many of the upgraded systems provided. All parties involved concluded that this highly challenging project was well managed and successful.

ACKNOWLEDGEMENTS

The authors would like to thank the staff at Metropolitan Water District of Southern California and in particular all the staff who provided input for this technical paper. We also want to thank Douglas Hilts, S.E. of Hilts Consulting Group, for his design expertise, cooperation and professionalism on this project as well as thank MWH Americas Inc., namely Kandarp Patel who worked with us on the project. Sven Falk, Construction Manager for Layfield Environmental Systems, also provided valuable technical and commercial support.

Hypalon® is the registered trademark of DuPont. Used with permission.

REFERENCES

American Society for Testing and Materials "ASTM D6497 Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures," West Conshohocken, PA.

American Water Works Association "AWWA California-Nevada Section Reservoir Floating Cover Guidelines, April 1999"

National Sanitation Foundation, "NSF/ANSI Standard 61 Drinking Water System Components" Ann Arbor MI.

American Water Works Association, "AWWA Standard for Disinfection of Water Storage Facilities, ANSI/AWWA C652," Denver CO.

American Society for Testing and Materials "ASTM D4437-08 – Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes," West Conshohocken, PA.