Sofia Water Tank Inspection Report

General

The water storage facilities at the embassy consist of two partially underground reinforced concrete water storage tanks. The two tanks share a common center wall and are each 91.76 square meters and 5.43 meters deep with a functional storage volume of 406.08 cubic meters. The overall condition of the tanks is good. The tanks were constructed and placed in service in 2003 at the time of the construction of the NEC. The tanks are partially underground in a separate pump room generator building on compound. The tanks are accessed by to locked manway hatches. Entry into the tanks is via a fiberglass ladder without fall arrest protection. The tanks were initially waterproofed with a cementitious, spray applied waterproofing compound.

Penetrations into the tanks from the pump / water treatment room are all through the southern wall of the tank and re located at various elevations in accordance with their purpose. There is a dedicated electric circuit providing lighting via a single fixture at the top of the manway.

A visual and physical inspection of the tanks was conducted on April 18 and 19, 2016. The visual inspection was conducted by observing all tank components and the tank structure. Physical inspection was conducted using a metal probe and 500g rebound hammer. The entire surface of the tank was sounded with the hammer at 300 intervals. Areas of suspected delamination were further tested with the rebound hammer and metal probe to identify areas of possible spalling. Tank appurtenances were inspected for signs of deterioration, and for operational problems.

Penetrations were observed for signs of sealant and seal deterioration. Areas of possible deterioration were probed and anomalies noted.

Observations

The following observations were made:

1. Ladder anchor bolts corroded- The ladder was installed using either low quality stainless steel or carbon steel anchors. These have corroded and should be replaced.
2. Fire pump anti-vortex plate supports- The supports under the anti-vortex plate have corroded and are no longer attached to the plate. They are generally in poor condition and should be replaced.
3. Fire pump intake pipe- The intake pipe for the fire pump is corroded, particularly where it attaches to the anti-vortex plate. The pipe should be cleaned, coated with a rust inhibitor and coated with an NSF 61 certified paint. After cleaning and before painting, bolts attaching the anti-vortex plate should be inspected. Bolts exhibiting excess material loss should be replaced. An improved arrangement would be to create a di-electric break between the plate and pipe using a rigid Teflon gasket and Teflon washers between the plate and pipe. Alternately, cathodic protection in the form of a zinc anode could be attached to the inlet pipe.

4. Tank vent- The tank vent pipe penetration in tank 1 did not appear to be properly sealed. This penetration should be sealed to prevent infiltration into the tank. Similarly, the vent riser seal has deteriorated and should be replaced on both tanks.
5. Lighting / power- The junction boxes, switches and lighting fixtures should be inspected. Corroded switches, convenience outlets and connections should be replaced. Lighting fixtures should be inspected and replaced if found to be in poor condition.
6. Access hatches- Access hatches are in good condition. Gaskets are intact, latching mechanisms operate freely, and lock hasps are sturdy. Flashing around hatches is in good condition. Sealant is intact and remains flexible.
7. Tank Structure- The tank structure was found to be in good overall condition. Several locations were found where concrete delamination around rebar were detected. In all of these areas, the concrete remained sound with no evidence of spalling observed. These areas are shown in the attached sketch. Evidence of past crack repairs were observed. These repairs consist of the application of additional brushed on cementitious sealer with and without woven fabric reinforcement. Evidence of delamination of the crack repairs were observed. Cementitious crack seal was applied along the entire joint between the wall and floor on the wall adjacent to the pump room. Evidence of seepage through this wall on the pump room side was observed.
8. Waterproofing- Waterproofing on the tank walls was in poor condition. In general, it appears that the waterproofing was not initially applied to the correct thickness, thereby limiting its effectiveness. Build up for this application should have been greater than 1.6mm, whereas the observed thickness was generally half that.

Recommendations

The following are recommendations for maintenance of the tank

1. Repair access ladder mounts – remount access ladders with 12.5mm drop in anchors fabricated of noncorrosive material such as 316-d Stainless steel, or phosphor bronze. Drop-in anchors should have a minimum pullout strength of 250 kg and a shear strength of 500 kg. Anchors should be installed in accordance with manufacturer's instructions.
2. Fire pump anti-vortex plate supports – Replace anti-vortex plate support with new supports fabricated of 316-D stainless steel or other corrosion resistant material.
3. Fire pump anti-vortex plate attachment bolts – clean and descale fire pump intake pipe. Examine and replace bolts exhibiting excess material loss. Consider installing di-electric break between plate and pipe, or zinc anode on pipe to prevent corrosion. Pipe should be coated with corrosion inhibitor and painted with an NSF 61 approved paint.
4. Pipe penetrations- remove all external sealant applied to pipe penetrations inside tank. Clean, apply corrosion inhibitor and paint seal clamps and clamping hardware or replace as necessary. Reapply external sealant to cleaned opening.
5. Install sealant to vent pipe penetration- Install sealant to vent pipe penetration from interior and exterior of tank.
6. Inspect and replace electrical lighting circuit within tank – Open boxes and inspect wiring connections. Replace corroded connections, fixtures, boxes, etc. Install new weather seals on boxes to remain.

7. Tank water proofing – Remove and replace waterproofing in tank. The following are necessary elements of this work:
    a. Product data and submittals- Prior to the commencement of work develop a work plan that includes: product data (all applied products must be NSF 61 or equal certified), worker confined space certifications, product applicator certification training, confined space entry plan, schedule for work, VARs for workers and equipment and other post specific requirements.
    b. Hydro-demolish existing coating – use high pressure water to remove all traces of existing waterproofing compound and to roughen existing surface in preparation for application of new waterproofing system. Surface roughening should be done to the extent / in accordance with manufacturer's instructions.
    c. Epoxy injection crack sealing- where observed cracks exceed 0.8mm, inject NSF 61 certified epoxy grout sealer into cracks in accordance with the manufacturer's instructions.
    d. Priming- In accordance with manufacturer's instructions, apply primer as required.
    e. Catalyzed polyurethane elastomeric coating- in accordance with manufacturer's instructions, apply coating system. Atmospheric and surface conditions stipulated by the manufacture for proper application should be monitored. Records of temperature, humidity, and moisture content of substrate shall be monitored and records provided to USG and other conditions stipulated by manufacturer, (if any) shall be provided to government. All monitored parameters must be within manufacturer's limits for installation of their product.

Other water treatment system recommendations

1. The original design called for orthophosphate addition to protect plumbing from corrosion. Presently, this is not being done. The installation of a new orthophosphate injection system in the process train immediately prior to the booster pumps is required to prevent corrosion. The orthophosphate should not be added to the recirculation system as originally contemplated because of chlorine probe fouling problems.
2. Replace diaphragm style chlorine injection pump with peristaltic pump. This will potentially require minor reprograming of Chlorine sensor PLC to operate with alternate pump type.
3. Order and have on hand if you do not already have the following parts for the water treatment system:
    a. GF – Signet 515/2536 chlorine sensor display and PLC
    b. Main control panel PLC (Direct Logic DO-06DD2-D)
    c. Filter screen for chlorine probe (several)
    d. chlorine probe (Kuntze Instruments Krypton K C12 0-4ppm 220V)
    e. solenoid for inlet valve 80mm 230V/1/50
    f. inlet solenoid valve body 80mm
    g. inlet solenoid valve diaphragm disk
    h. Replacement limit switch (several) for water level (Barksdale LSSM level switch 4-20mA)
    i. Rotary flow sensor (GF-Signet 515/2536 Rotary flow sensor (rotor assembly))

j. Replacement recirculation pump for chlorine injection system (Gould 3656/3756 8.52 L/s @193.05 KPA)
k. Manual gages (Weksler BY11YPF4LW)

Images

Image 1 - Repaired Cracks

Image 2 - Recirculation intake penetration

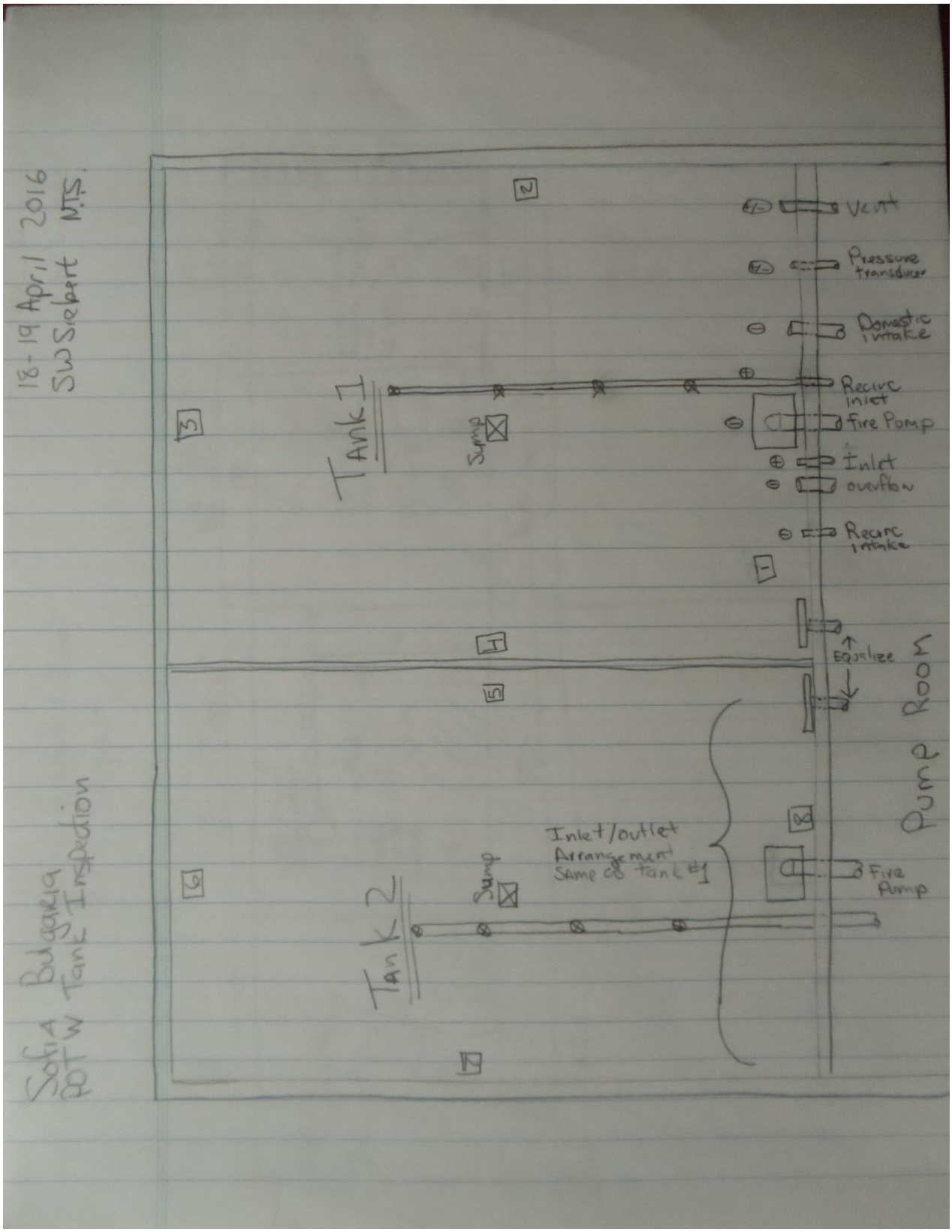
Image 3 Fire Pump Inlet

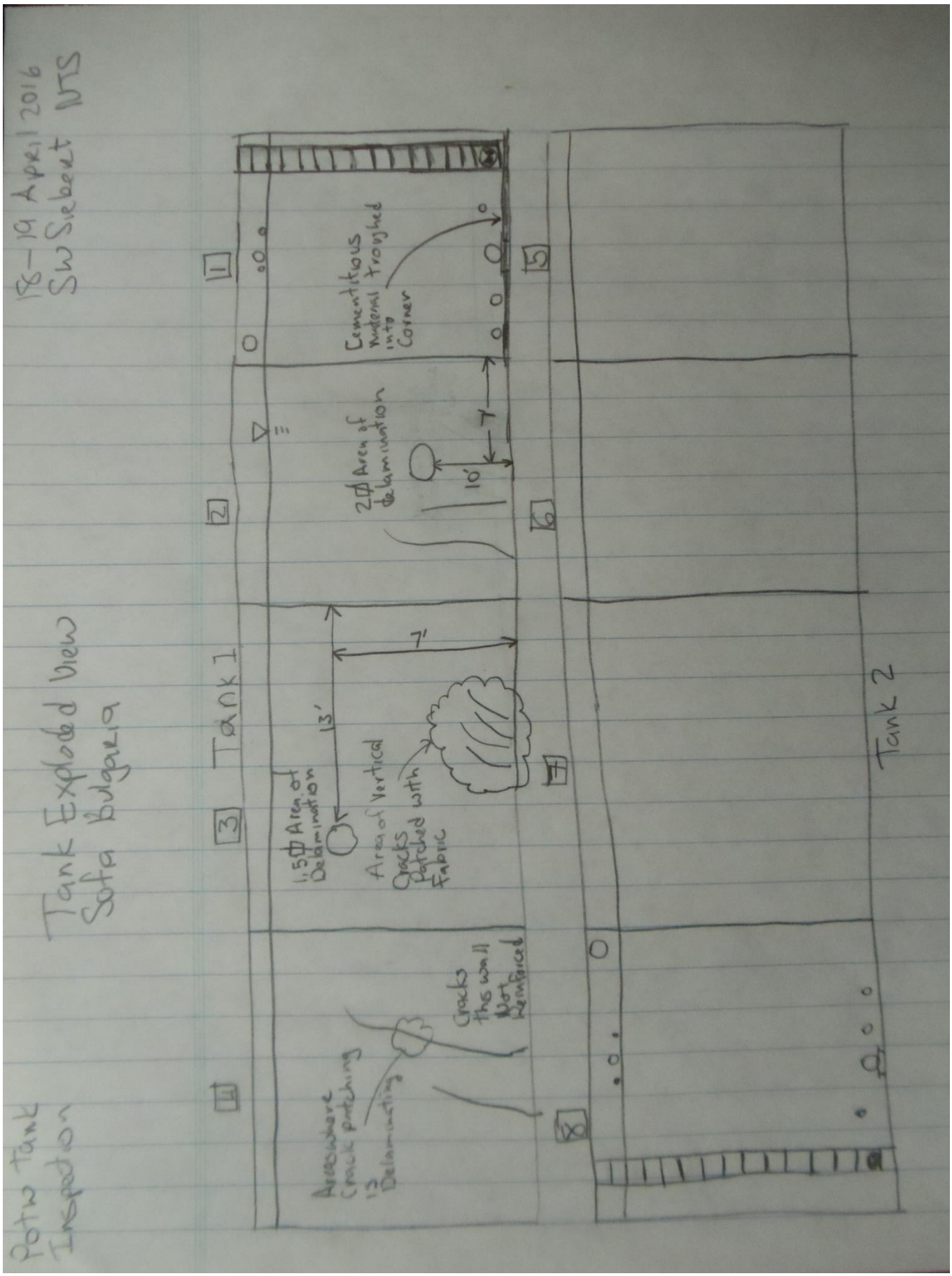
Image 4 - Water level Pipe Penetration

Image 5 - Corroded ladder anchors

Image 6 - Unsealed vent / overflow

Sketches


18-19 April 2016
SW Siebert
N.T.S.
Sofia Bulgaria
POTW Tank Inspection
Vent
Pressure transducer
Domestic intake
Recirc inlet
Fire Pomp
Inlet
overflow
Recirc intake
Equalize
Pump Room
Tank 1
Sump
Inlet/outlet Arrangement Same as Tank #1
Tank 2
Sump
Fire Pump


Potw Tank Inspection
Tank Exploded View
Sofia Bulgaria
18-19 April 2016
Sw Siebert NTS
Tank 1
Tank 2
Cementitious material troweled into Corner
2# Area of delamination
10'
7'
1.5# Area of Delamination
13'
7'
Area of Vertical Cracks Patched with Fabric
Cracks the wall Not Reinforced
Areas where crack patching is Delaminating