DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF RDRL-WMM-C 17 SEP 2012

MEMORANDUM FOR NATIONAL CAPITAL PLANNING COMMISION

SUBJECT: Eisenhower Memorial Corrosion Resistant Materials Findings

1. Tapestry Materials Selection: Prior to attending the National Capital Planning Commission (NCPC) meeting held on July 31, the low carbon stainless steel alloy 316L was my initial favored alloy based upon its superior corrosion resistance and resistance to sensitization at weld sites versus the more common and less costly 304, 304L, and 316 stainless steel alloys. In addition to the 304L and 316L alloys, the option of selecting 317L as a possible tapestry alloy was also discussed at the meeting. Based upon further study and subsequent discussions among ARL colleagues I fully concur with 317L as the preferred alloy choice. The additional Molybdenum in 317L further increases the surface corrosion resistance, resistance to pitting, and also is an effective scavenger for remaining carbon and other impurity elements that can impact corrosion resistance of the base material. These inherent properties are especially crucial at and near the vicinity of welds that are the major basis of the memorial tapestry. The ability of the Mo to form carbides also helps to ensure that the Cr will retain its critical alloy concentrations in and around the weld fusion zones and that nucleation of $Cr_{23}C_6$ carbides during weld events will be prevented or greatly suppressed thus greatly enhancing the corrosion resistance and lifespan of the tapestry.

2. Post-Assembly Pickling and Passivation: In order maximize the lifespan of the stainless steel tapestry panels, it is recommended that the individual tapestry panel assemblies are each pickled and passivated prior to placement at the memorial site. The pickling will remove the discolored areas from high heating on and adjacent to the welds where chromium levels are sometimes reduced. Pickling is done through immersion in hydrofluoric and nitric acid mixtures per the ASTM A380 specification that is already included in Section 6.1 of the Eisenhower Memorial Tapestry Engineering and Technical Data Summary Notebook. After pickling, a final passivation step through immersion in nitric acid once again in accordance with ASTM A380 will build and optimize the passive layer thus maximizing the corrosion resistance.

3. Corrosion Assessment of Tapestry Alloys: The 1000 hour ASTM B 117 neutral salt fog (NSF) evaluation in the initial studies helped to demonstrate that stainless steel alloys were viable corrosion resistant materials to use for the tapestry. While the NSF environment is indeed severe for most uncoated metallic materials, the 1000 hour duration was inadequate for determining differences in inherent corrosion resistance among different austenitic (300 series) stainless steel alloys. In order to provide more timely determinations of relative corrosion resistance levels among the candidate 300 series stainless steel alloys a harsher accelerated corrosion environment is needed. The SO_2 salt fog used by the U.S. Navy Air Warfare Center (NAVAIR) at Patuxent

River, MD to more readily simulate the jet exhaust and other pollution effects from carrier deck operations will more readily differentiate between the candidate alloys and their surface treatment states. Furthermore, the SO_2 will also better simulate and accelerate pollution conditions of an urban or industrial environment. It is recommended that welded surrogates of each candidate alloy configured under tensile loads with and without the pickling and passivation treatments form the basis of the finalist materials matrix. A standardized tapestry corrosion coupon design is recommended for this task. This specimen should ideally incorporate as many aspects as possible from the actual tapestries. In addition to possessing precisely set tensile preloads from in-service conditions, each specimen should ideally contain all types of wires, woven strands, and weld joints that will be used throughout the tapestry. Prior to exposure, the greatest of care should be taken to ensure that all specimens are identical in physical dimensions of the wires, their orientations, the welds, and the applied tensile loads. The point of contact for SO_2 salt fog at NAVAIR is Mr. Craig Matzdorf, 301-342-9372, craig.matzdorf@navy.mil.

4. Design and operational strategies for 100 Year Long-term Memorial Durability: At the 31 July NCPC it was suggested that an identical set of duplicate tapestries be considered as part of an interchangeable modular system. The use of an interchangeable system of tapestry panel duplicates would minimize unsightly disruptions at the memorial site by having “new” panels immediately available for fast onsite exchanges. The ability to then refurbish and repair the degraded or damaged tapestry panels under ideal conditions at an offsite location would ensure the highest quality and would enhance overall memorial safety versus the alternative of onsite in-situ repairs of single copy tapestry panels. When exchanged, the older panels could easily be restored to near new conditions via re-welds to reattach missing or damaged wires followed by pickling, and passivation at minimal cost levels and could be stored in reserve until the partner panel is ready for its cycle of maintenance. The extra panels would also be good insurance in the event of any unforeseen catastrophic events such as vehicle collisions, crane accidents, tree falls, or accidents during maintenance. President Eisenhower, greatly admired for his mastery of planning and preparing for complex operations once quoted: *“You will not find it difficult to prove that battles, campaigns, and even wars have been won or lost primarily because of logistics”*. Through this rotation method, the 100-year life cycle should be easily attainable and likely even exceeded and would reflect well upon President Eisenhower’s legacy.

5. Remaining Ice Loading Issues: At the 31 July NCPC meeting the issue of ice loading was discussed. From the project notebook materials in Sections 3.2 and 3.3 it is evident that extensive considerations went into designing the tapestries to be strong enough to bear the static ice loads and the dynamic ice loads with wind. One issue that

was perhaps not as well considered was the aftermath or transitional conditions produced from the inevitable melting of heavy icing. These conditions would consist of partial melting followed by potential releases of heavy ice sections that could injure memorial site visitors or passing pedestrians unfortunate enough to be located underneath the structure at one of these release events. Other than simply having the U.S. National Park Service cordon off the site during ice melt periods, perhaps a series of modular winter shields or ice breakup bars situated at the bottom edges of the tapestries for use during the winter months could be used. These shields could be stored where the duplicate tapestry panels would be housed. Another consequence could be high localized torque events created by partial melts in sun lit portions with heavy sections of ice pulling away while remaining fixed or frozen at a lower points in shade. These partial release conditions of heavy ice could create large twisting or bending moments perhaps in excess of maximum anticipated loads and should be further reviewed before the tapestry design and welding configurations are finalized.

6. The point of contact for this action is Mr. Brian Placzankis, brian.e.placzankis.civ@mail.mil, 410-306-0841.

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