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June 6, 2011
Project No. DRMAP3

Mr. Keith E. Carney
Vice President of Engineering & Quality Assurance
MIDDLE ATLANTIC PRODUCTS
300 Fairfield Road
Fairfield, New Jersey 07004

Subject: *Second Revised Seismic Certification of WRK Series 19-inch Multi-Bay Rack Enclosures installed with Seismic Anchoring Kit*

Reference: *"Seismic Qualification of the WRK, MRK, and AX-S Series Racks with Seismic Anchorage Kit". Technical Report. EQE International, Inc. EQE Project No. 200082.01. January 1998.*

"Seismic Qualification of the WRK, MRK, and ERK Series Racks with Seismic Anchorage Kit". Technical Report. EQE International, Inc. EQE Project No. 200082.01. April 1997.

Sent via electronic mail to kcarney@middleatlantic.com

Dear Mr. Carney:

At your request, Halcrow Inc. (Halcrow) has reviewed the previously completed test reports referenced above and has updated the capacities of the subject rack enclosure series in accordance with the provisions of the 2010 Edition of ASCE Standard 7 (ASCE 7-10), which is the basis for the 2009 and 2012 IBC, 2010 CBC, and the 2009 edition of NFPA 5000. These updated capacities are reported herein.

The referenced reports noted above describe a seismic testing program and provide test results for the WRK and WRK-SA Series enclosures. The reports indicate that the subject enclosures have sufficient seismic capacity to withstand lateral loads equal to those specified in the 1994 Uniform Building Code (UBC) for essential facilities where the weight of the enclosure contents does not exceed 1,000 pounds.

As noted in the referenced reports, the enclosures selected for testing represent each of the footprints (defined by the width and depth of the enclosure) for the various models within the WRK and WRK-SA Series. In addition, the enclosures tested were the tallest in the series and represent the worst seismic load case for a given footprint. The enclosure frame and anchorage details for each footprint within the series are identical, regardless of height. Therefore, the testing results for the tallest enclosures are applicable to all of the enclosures with equal or lesser height with the same footprint.

The tested WRK and WRK-SA Series enclosures were loaded such that the contents were distributed uniformly over the height of the rack. The loaded enclosures were anchored to an inclining test frame with the appropriate seismic anchorage kit and slowly tipped to a target angle to simulate lateral seismic loading. At maximum inclination, each enclosure was observed for any signs of distress or extreme deformations, and overall enclosure drift was measured. Removal of the rack-mounted weights was observed to assess the ease of their removal. All enclosures were tested both in the front-to-back and side-to-side directions. A summary of the reported lateral seismic test results are provided in Table 1.

At maximum inclination, none of the enclosures listed in Table 1 were reported as showing any signs of significant distress. No visible permanent deformations were observed after the test load was removed. The maximum drift ratio measured for the tested WRK enclosure was 1.20% of the enclosure height during the application of maximum lateral load in the side-to-side direction. This was reported as the maximum drift of all enclosures tested; therefore it can be inferred that the overall drift of the WRK-SA enclosure was less. No difficulty was reported in removing rack components from any of the tested enclosures. However, for essential equipment, the intent of most building construction codes is to provide reasonable assurance that equipment required to function after an earthquake will be operable. While the measured drifts do not compromise the structural integrity of the enclosure, the effect of the deformation on the operability of essential equipment mounted in the rack enclosure is unknown.

Based on the reported test results for 1994 UBC seismic lateral loads, Halcrow concludes that the WRK and WRK-SA Series seismic riser bases have sufficient seismic adequacy to support the enclosure weight capacities (enclosure self-weight plus content weight) listed in Table 2 for the various building construction codes considered. Capacities for the double bay risers are interpreted based on the bounding results of the single and triple bay test data. These seismic capacities are appropriate for all models within the series with the same or lower height. The building codes selected for consideration are as follows:

- 1997 Uniform Building Code (UBC) which is the basis for the 2001 California Building Code (CBC)

- 2000 International Building Code (IBC)
- 2002 Edition of ASCE Standard 7 (ASCE 7-02) which is the basis for the 2003 IBC and the 2003 edition of the National Fire Prevention Association Building Construction and Safety Code (NFPA 5000)
- 2005 Edition of ASCE Standard 7 (ASCE 7-05) which is the basis for the 2006 IBC, 2007 CBC, and the 2006 edition NFPA 5000
- 2010 Edition of ASCE Standard 7 (ASCE 7-10) which is the basis for the 2009 and 2012 IBC, 2010 CBC, and the 2009 edition NFPA 5000.

These are the primary building codes that govern construction in the most earthquake-prone regions of the country. The seismic content capacities provided in Table 2 are generic in nature to cover all possible installations. These capacities are based on project locations with the highest level of seismicity and top floor or rooftop installations, where amplification of seismic shaking is greatest. As such, riser bases installed at sites with less seismicity or on lower floors may have content capacities greater than those provided.

Table 2 provides a listing of acceptable capacities for riser bases installed at locations with the highest seismicity (UBC & 2001 CBC – Zone 4, Ca=0.44; ASCE 7-02, 2000 IBC, 2000 & 2003 IBC, & 2003 NFPA 5000, SMS=2.56g; ASCE 7-05/10, 2006/2009/2012 IBC, 2007/2010 CBC, & 2006/2009 NFPA 5000, SMS=2.85g). Two categories of acceptable capacities are provided; one for "high-importance" installations and the other for standard installations. The "high-importance" category applies to installations within Essential facilities as defined in the UBC and CBC as well as for installations within Seismic Use Group III facilities as defined in the IBC, ASCE 7, and NFPA 5000. These installations are generally for facilities where reasonable operation of the facility and/or certain equipment items following an earthquake is desired. The design for these "high-importance" installations use an importance factor (I_p) of 1.5. The other category shown in Table 2 is for standard or for all other installations where the building codes generally assign an importance factor of one.

Please note that the observations and conclusions noted herein are applicable only to the WRK and WRK-SA Series enclosures when anchored using the appropriate seismic brackets provided by Middle Atlantic Products. Selection and installation of rack enclosure anchor bolts are the responsibility of the end user and are not addressed in this evaluation. Any changes to the enclosure design, fabrication, materials, and anchorage may invalidate these observations and conclusions.

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If you have any questions or comments, please feel free to contact me directly by phone or email (wbruin@halcrow.com).

Very truly yours,
Halcrow, Inc.

William M. Bruin, P.E.
Principal Engineer

California Civil C57867 (expires June 30, 2012)

Table 1
SUMMARY OF WRK & WRK-SA SERIES RACK ENCLOSURE TESTING RESULTS

Enclosure[1] (Test Year)	Estimated Lateral Test Load[2] (pounds)	Enclosure Drift @ Maximum Inclination (% of Enclosure Height)		Enclosure Drift After Testing (% of Enclosure Height)		Were Weights Easily Removed following Testing?
		Front-Back	Side-Side	Front-Back	Side-Side	
WRK-44-27 (1997)	1,200	Not Reported	1.20%	Not Reported	Not Reported	Yes
WRK-44SA-27 (1997)	1,200	Not Reported	Less than 1.20%	Not Reported	Not Reported	Yes

[1] The tallest of the WRK and WRK-SA Series enclosures represented the worst seismic load case for a given footprint (defined by the width and depth of the enclosure).

[2] Lateral test load based on enclosure weight, 1,000 lbs of contents, and 1994 UBC base shear coefficient for essential facilities.

Table 2
SEISMIC CERTIFIED CONTENT CAPACITY FOR WRK AND WRK-SA SERIES RACK ENCLOSURES (pounds)[1,2,3]

Enclosure	High-Importance Installations[4]			Standard Installations		
	1997 UBC 2001 CBC	ASCE 7-02 2000 IBC 2003 IBC 2003 Ed. NFPA 5000	ASCE 7-05/10 2006/09/12 IBC 2007/10 CBC 2006/09 Ed. NFPA 5000	1997 UBC 2001 CBC	ASCE 7-02 2000 IBC 2003 IBC 2003 Ed. NFPA 5000	ASCE 7-05/10 2006/09/12 IBC 2007/10 CBC 2006/09 Ed. NFPA 5000
WRK-XX-27	909	922	822	1,364	1410	1261
WRK-XX-32	909	922	822	1,364	1410	1261
WRK-XX-SA-27	909	922	822	1,364	1410	1261
WRK-XX-SA-32	909	922	822	1,364	1410	1261

[1] Capacities provided are for enclosures anchored using the appropriate seismic brackets provided by Middle Atlantic Products. Selection and installation of enclosure rack anchor bolts are the responsibility of the end user and are not addressed in this evaluation.

[2] Capacities provided are applicable when contents are uniformly distributed over the height of the enclosure.

[3] Capacities provided are based on worst case seismicity (UBC & 2001 CBC – Zone 4, Ca=0.44; ASCE 7-02, 2000 IBC, 2000 & 2003 IBC, 2003 NFPA 5000 – S_{MS}=2.56g; ASCE 7-05/10, 2006/09/12 IBC, 2007/10 CBC, 2006/09 NFPA 5000 – S_{MS}=2.85g) and top floor or rooftop installation. Additional capacity may be available based on site-specific evaluation.

[4] High-Importance Installations include those within UBC and CBC Essential facilities or IBC, ASCE 7, and NFPA 5000 Seismic Use Group III facilities. For all codes, the Importance factor (Ip) is 1.5.

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