21 September 2016

Mr. Angelo Cacciatore
Product Safety & Compliance Engineer
MIDDLE ATLANTIC PRODUCTS
300 Fairfield Road
Fairfield, NJ 07004

Project 167535 – Middle Atlantic Products, 2016 Seismic Testing

Re: Observed Seismic Performance of the SNE Series Enclosures

Dear Mr. Cacciatore:

At your request, William Bruin, P.E. of Simpson Gumpertz & Heger Inc. (SGH) observed seismic qualification testing of the SNE series rack enclosures. The testing was conducted at Middle Atlantic Products, Inc. (Middle Atlantic) Fairfield, New Jersey facility on 23 May and 24 May 2016. This letter supersedes all previous SNE test observation letters as the frame design of the enclosures has changed. This letter is only valid for SNE enclosures designated as "SNE Redesign (DFM) EC # 7939."

The SNE series enclosures selected for testing are listed in Table 1. These enclosures are the tallest models in the series, with the largest and smallest footprints, respectively. As the enclosure frame and anchorage details for each footprint within a series are identical, regardless of height, the tested enclosures represent a worst case for seismic loading; and testing results for the tallest enclosures are applicable to all other SNE series enclosures with equal or lesser height and the same footprint. Therefore, the tested enclosures are considered to bind the results for all enclosures in the series.

TEST PROCEDURE

Each enclosure was statically tested on an inclined test frame. Prior to testing, each enclosure was mounted on the test frame with an SNE-Z4 seismic anchorage kit. The racks were then loaded with rack-mounted weights, positioned such that 50% of their total weight was placed in the bottom third of the enclosure rack height, 25% in the middle third, and 25% in the top third.

After installation we made initial observations and measurements of geometry. Then, the entire assembly was slowly tipped to a target angle to simulate lateral seismic loading. At maximum inclination, we again observed the enclosure for any signs of distress or extreme deformations, and also measured overall enclosure drift. During testing a tether strap is attached to the top of the frame for added safety in the event of frame or anchorage failure; at maximum inclination it is also verified that the strap is not in tension, and therefore not carrying any load.

The enclosure was then lowered back to its original at-rest position and inspected for signs of permanent deformation. We measured the unit again, in the lowered position, to estimate final drift. The enclosures were tested first in the back-to-front direction, then rotated 90 degrees and tested for side-to-side loading.

We determined the quantity of weight for each test based on the enclosure's target content capacity rating, the self-weight of the enclosure, and the seismic design force requirements for nonbuilding components. The specifics of the seismic design criterion are described further within the later sections of this letter report.

OBSERVATIONS

The tested enclosures performed adequately under the lateral loading, remaining structurally sound throughout the test and functional for purpose after test completion. Table 1 summarizes the applied loads for the tested enclosures. Photos 1 through 8 show the tested cabinets at maximum inclination, in each of the two directions of testing.

At maximum inclination, none of the enclosures showed signs of significant distress. No difficulty was encountered removing the rack components from either of the tested enclosures following testing. Evaluation of the operability of actual equipment installed on this rack is beyond the scope of this test program and is the responsibility of the end-user.

Table 1: Summary of Test Results[1]

Enclosure	Lateral Test Load[2] (pounds)	Enclosure Drift (%) (Top Displacement / Height)			
		Loaded to Max Inclination		Permanent after Testing	
		Front-Back	Side-Side	Front-Back	Side-Side
SNE-24-5436	1,824	1.40%	0.83%	0.26%	0.23%
SNE-24-5448	1,841	1.09%	1.39%	0.01%	0.35%
SNE-30-5436	1,829	1.38%	1.62%	0.07%	0.23%
SNE-30-5448	1,832	1.41%	1.37%	0.07%	0.20%

1 Results provided are based on testing discussed herein.

2 Lateral test load based on enclosure weight, weight of contents, and test inclination. This is equivalent to code seismic base shear.

SEISMIC CONTENT CAPACITIES

The capacities presented herein are based on the testing of the SNE enclosures, as noted above, and the following building codes:

- 2010 Edition of ASCE Standard 7 (ASCE 7-10) which is the basis for the 2012 International Building Code (IBC) and 2013 California Building Code (CBC)

- 2010 National Building Code of Canada (NBC 2010) which is the basis for the 2012 Edition of the British Columbia Building Code (BCBC 2012)

For all reported values, the seismic design force is determined using an assumed Site Class D soil condition, and assumed top floor or rooftop installations, where amplification of seismic shaking is greatest. The capacities were computed for High Importance installations and for Standard installations. The High Importance category applies to installations within or attached to Occupancy Category IV facilities as defined in the IBC, CBC, and ASCE 7; installations required to function for life-safety purposes after an earthquake; and components supporting any hazardous substances. In the NBC this category is referred to as a “Post-disaster” importance category. Design for these High Importance or Post-disaster installations uses an importance factor (I_p or I_E) of 1.5. The Standard installation category (referred to as “Normal” in the NBC) includes all other installations and uses an importance factor of 1.0.

The capacities in Table 2 are considered a worst case seismicity per current building codes, since the seismic design force is based on the largest mapped accelerations within the Continental US and Canada, for ASCE7-10 and NBC 2010, respectively. This approach provides capacities that are the most generic in nature, covering all possible installations. As such, enclosures installed at sites with less seismicity or on lower floors may have content capacities greater than those provided. These capacities are valid for floor installations as well as those upon Middle Atlantic seismic riser bases (SRBs).

Tables 3 and 4 provide alternate capacities based on lower seismicity scenarios, for High Importance and Standard Installations, respectively. For each SNE model and capacity level, a maximum seismicity is specified; whereby the content capacity shown is applicable to all locations with seismicity equal to or less than the maximum seismicity listed. These tables provide additional capacity levels at more realistic seismicity levels; however capacities should not be interpolated from the tables. Additional capacity may be found by conducting a site-specific evaluation considering the site seismicity and installation location.

Table 2: Seismic Capacity (pounds) at Maximum Seismic Condition[1,2,3]

Enclosure	High Importance / Post-disaster Installations[4]		Standard / Normal Installations	
	ASCE 7-10	NBC 2010	ASCE 7-10	NBC 2010
SNE-24-XX36	1076	448	1698	755
SNE-24-XX42	1000	400	1580	690
SNE-24-XX48	1071	437	1699	747
SNE-27-XX36	1000	400	1580	690
SNE-27-XX42	1000	400	1580	690
SNE-27-XX48	1000	400	1580	690
SNE-30-XX36	1081	448	1708	758
SNE-30-XX42	1000	400	1580	690
SNE-30-XX48	1074	443	1698	752

1 Capacities provided are for the SNE series enclosures, up to 54 rack spaces tall. Selection and installation of the enclosure rack anchor bolts are the responsibility of the end user and are not addressed in this evaluation.

2 Capacities provided are applicable when 50% of the enclosure contents are positioned in the bottom third of the rack, 25% in the middle third, and 25% in the top third.

3 Capacities are based on worst case seismicity ($S_{DS} \leq 2.04g$ for ASCE 7-10; $F_a * S_a(0.2) \leq 2.20g$ for NBC 2010) and top floor or rooftop installation. Additional seismic capacity may be available based on a site-specific evaluation of the installation location.

4 High Importance Installations include any installation where ASCE 7 defines a component importance factor (I_p) of 1.5; including (but not limited to) Occupancy Risk Category IV structures. Post-disaster Installations are similarly defined in NBC to have an importance factor for earthquake loads and effects, I_E of 1.5.

Table 3 – Maximum Seismicity (g) for High Importance / Post-disaster Installations[1,2,3,4]

Enclosure	800 lbs Capacity		1200 lbs Capacity		2000 lbs Capacity	
	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤
SNE-24-XX36	2.63	1.40	1.86	0.99	1.17	0.62
SNE-24-XX42	2.3	1.2	1.6	0.9	1.0	0.5
SNE-24-XX48	2.60	1.39	1.85	0.99	1.17	0.62
SNE-27-XX36	2.3	1.2	1.6	0.9	1.0	0.5
SNE-27-XX42	2.3	1.2	1.6	0.9	1.0	0.5
SNE-27-XX48	2.3	1.2	1.6	0.9	1.0	0.5
SNE-30-XX36	2.65	1.41	1.88	1.00	1.18	0.63
SNE-30-XX42	2.3	1.2	1.6	0.9	1.0	0.5
SNE-30-XX48	2.61	1.39	1.88	0.99	1.18	0.63

1 Capacities provided are for the SNE series enclosures, up to 54 rack spaces tall. Selection and installation of the enclosure rack anchor bolts are the responsibility of the end user and are not addressed in this evaluation.

2 Capacities provided are applicable when 50% of the enclosure contents are positioned in the bottom third of the rack, 25% in the middle third, and 25% in the top third.

3 Maximum seismicity values are based on top floor or rooftop installation. Maximum "seismicity" is defined as the design short period spectra acceleration, S_{DS} (equal to $2/3*F_a*S_s$ (mapped MCE)) for ASCE7 criteria, and $F_a*S_a(0.2)$(mapped hazard) for NBC criteria. For a given enclosure model, the content capacity shown is applicable to all locations with seismicity equal to or less than the maximum seismicity listed. Additional seismic capacity may be available based on a site-specific evaluation of the installation location.

4 High Importance Installations include any installation where ASCE 7 defines a component importance factor (Ip) of 1.5; including (but not limited to) Occupancy Risk Category IV structures. Post-disaster Installations are similarly defined in NBC to have an importance factor for earthquake loads and effects, I_E of 1.5.

Table 4 – Maximum Seismicity (g) for Standard / Normal Installations[1,2,3]

Enclosure	1000 lbs Capacity		1500 lbs Capacity		2400 lbs Capacity	
	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤	ASCE 7 2005/2010 S_{DS}≤	NBC 2005/2010 $F_aS_a(0.2)$≤
SNE-24-XX36	3.26	1.74	2.28	1.22	1.48	0.79
SNE-24-XX42	2.9	1.5	2.0	1.1	1.3	0.7
SNE-24-XX48	3.24	1.73	2.28	1.22	1.48	0.79
SNE-27-XX36	2.9	1.5	2.0	1.1	1.3	0.7
SNE-27-XX42	2.9	1.5	2.0	1.1	1.3	0.7
SNE-27-XX48	2.9	1.5	2.0	1.1	1.3	0.7
SNE-30-XX36	3.29	1.76	2.31	1.23	1.48	0.80
SNE-30-XX42	2.9	1.5	2.0	1.1	1.3	0.7
SNE-30-XX48	3.25	1.74	2.31	1.22	1.48	0.79

1 Capacities provided are for the SNE series enclosures, up to 54 rack spaces tall. Selection and installation of the enclosure rack anchor bolts are the responsibility of the end user and are not addressed in this evaluation.

2 Capacities provided are applicable when 50% of the enclosure contents are positioned in the bottom third of the rack, 25% in the middle third, and 25% in the top third.

3 Maximum seismicity values are based on top floor or rooftop installation. Maximum "seismicity" is defined as the design short period spectra acceleration, S_{DS} (equal to $2/3*F_a*S_s$ (mapped MCE)) for ASCE7 criteria, and $F_a*S_a(0.2)$(mapped hazard) for NBC criteria. For a given enclosure model, the content capacity shown is applicable to all locations with seismicity equal to or less than the maximum seismicity listed. Additional seismic capacity may be available based on a site-specific evaluation of the installation location.

CONCLUSIONS

Based on this assessment, SGH concludes that the SNE Series rack enclosures have sufficient seismic load resistance to support the content capacities listed in Tables 2 through 4, for the various building construction codes considered. Additional capacity may be found by conducting a site-specific evaluation considering the site seismicity and installation location. These seismic capacities are appropriate for all models within the series with the same footprint as those tested, and with the same or lower total height and weight. These capacities are also appropriate for floor installations as well as those upon Middle Atlantic seismic riser bases (SRBs).

Please note the conclusions noted herein are applicable only to the SNE Series enclosures when anchored using the Middle Atlantic SNE-Z4 seismic anchorage kit. 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 conclusions.

If there are any questions or comments, please feel free to contact me directly at 510-457-4600.

Sincerely,

Simpson Gumpertz & Heger Inc.

9/21/2016

William M. Bruin
Senior Principal
CA License No. C57867

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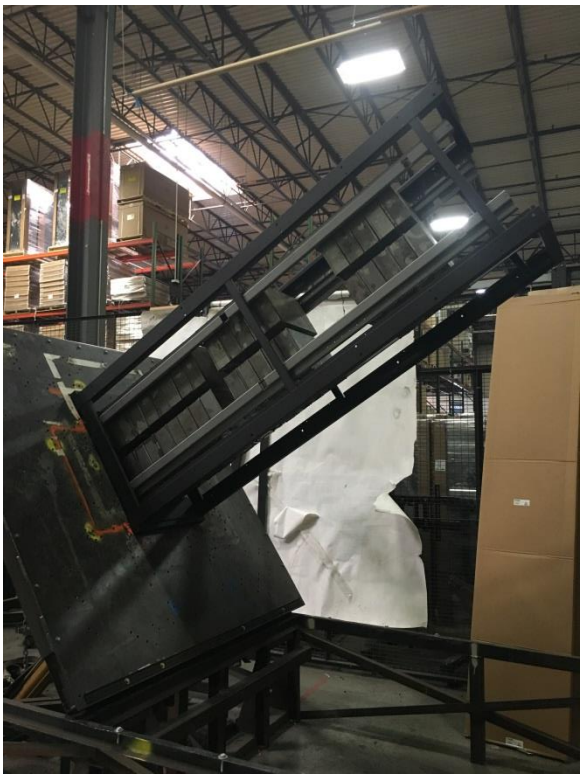

Photo 1

SNE-24-5436 at maximum inclination in back-to-front direction

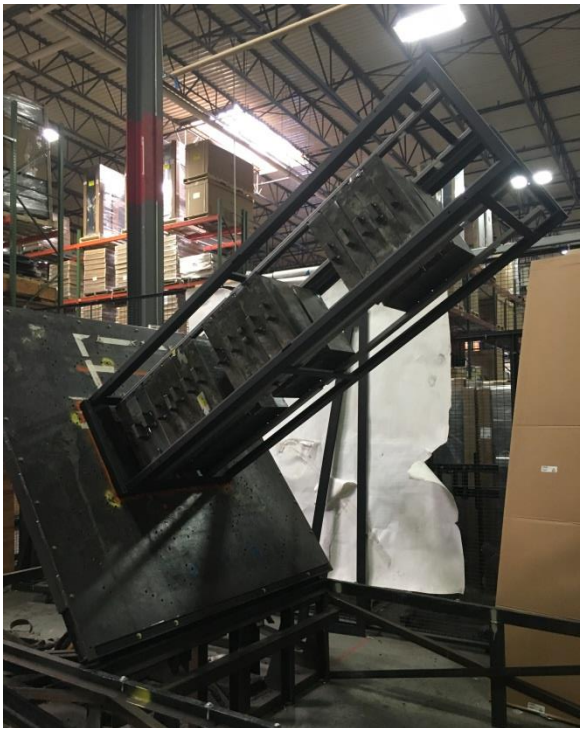

Photo 2

SNE-24-5436 at maximum inclination in side-to-side direction

Photo 3

SNE-24-5448 at maximum inclination in back-to-front direction

Photo 4

SNE-24-5448 at maximum inclination in side-to-side direction

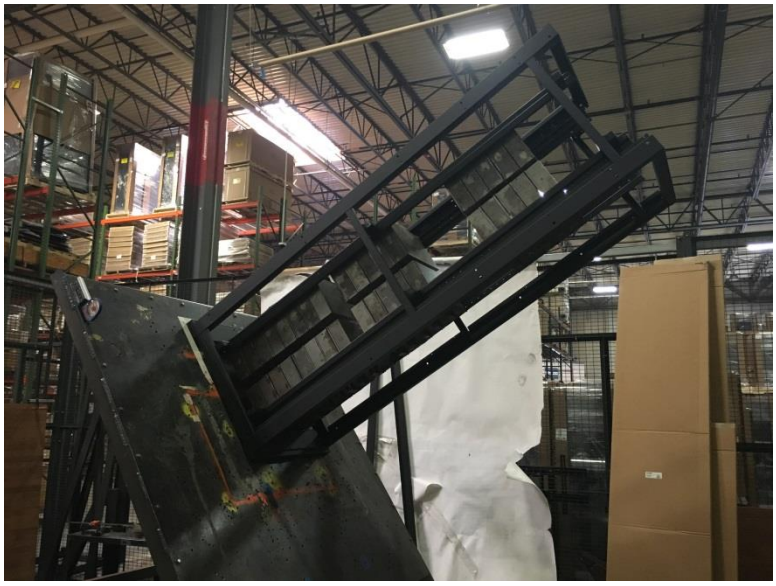

Photo 5

SNE-30-5436 at maximum inclination in back-to-front direction

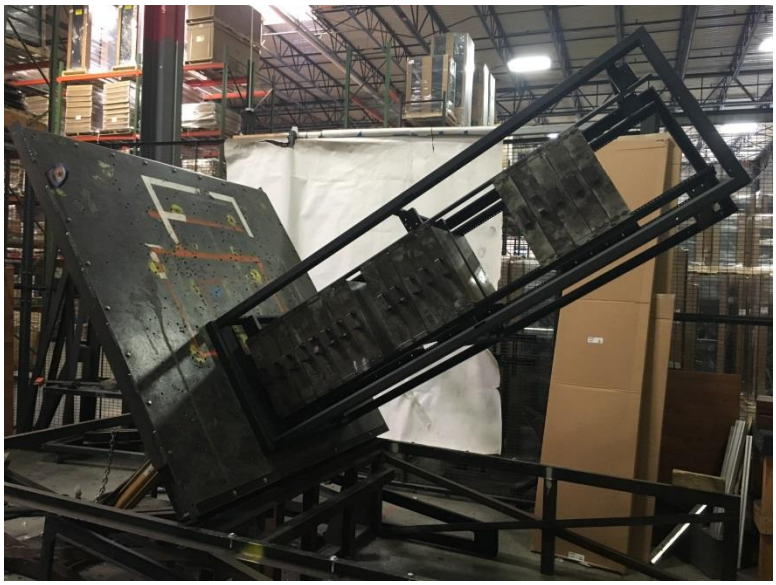

Photo 6

SNE-30-5436 at maximum inclination in side-to-side direction

Photo 7

SNE-30-5448 at maximum inclination in back-to-front direction

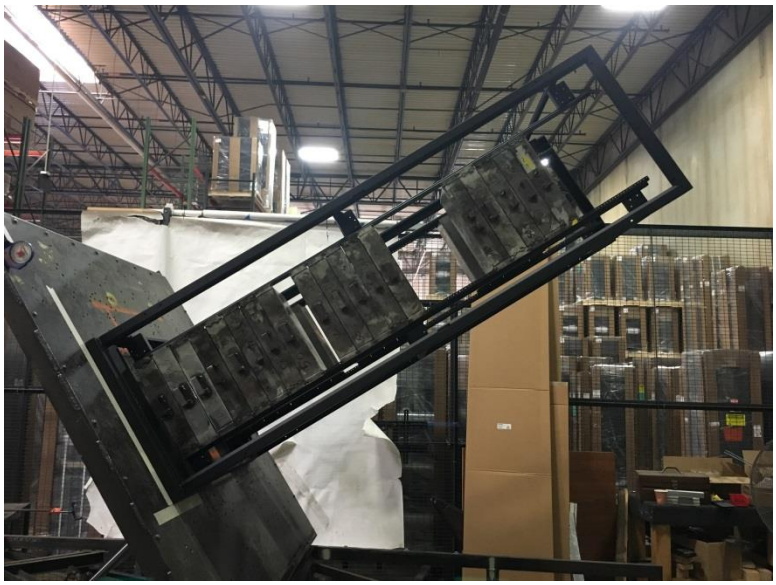

Photo 8

SNE-30-5448 at maximum inclination in side-to-side direction