TA Station Selection Strategy and Recommendations
Central and Eastern United States

TASS Working Group
27 April 2012

Working Group Considerations

Form a working group of earth science professionals representing a variety of stakeholder organizations and with regional diversification to prioritize selection of EarthScope Transportable Array (TA) stations for long-term operations, in order to improve earthquake monitoring and reporting, seismic hazard assessments and solid earth research in the central and eastern United States (CEUS). The working group shall report to both the ANSS Steering Committee, a subcommittee of the FACA Scientific Earthquake Studies Advisory Committee of the USGS Earthquake Hazards Program; and to the USArray Advisory Committee, which reports to the IRIS Board of Directors.

Background

As the EarthScope Transportable Array moves across the CEUS, we seek the opportunity to extend the observational period for five or more years of a large number of TA stations, in order to gain improved seismic monitoring through leveraging of the TA investment. Some of these stations could be kept permanently, as future funding allows. In 2011, IRIS suggested that one out of every four TA stations could be adopted, resulting in up to 250 new seismic stations in the region. Also in 2011, the USGS finalized a study for U.S. Nuclear Regulatory Commission (NRC) in which the USGS determined that at least 25 additional broadband and strong motion stations are needed to support the NRC's research goals and to support that agency's oversight responsibilities[1]. The needs of the USGS include seismological data to support the US National Seismic Hazard mapping program, which forms the basis of the building codes used in the United States, and the USGS National Earthquake Information Center and regional seismic networks in the CEUS.

A coordinated approach was developed to suit both missions and became incorporated in the President's 2013 budget proposal for NSF to, "include $3.0 million for the first year of a 5-year, $15.0 million project for the capital acquisition, long-term siting and near-term operation of up to 250 EarthScope Transportable Array stations to be left in the central and eastern United States after the TA's proposed move to Alaska beginning in 2014." While the original motivation focused on the needs of the NRC and USGS, the working group was composed of members representing broad expertise to

[1] USGS (2011), "Improved Earthquake Monitoring in the Central and Eastern United States in Support of Seismic Assessments for Critical Facilities" USGS Open File Report 2011–1101

assure, to the extent possible, that the new stations would meet the needs of universities researcher and state and federal organizations.

Charge

Review the existing permanent seismic stations, from the area of approximately 100°W to the easternmost tip of Maine; and the USArray/TA station grid for the same region;

- Identify 250 sites consistent with the installed or planned USArray/TA grid (using TA grid names and approximate latitude and longitude), where additional broadband and/or strong motion station coverage is needed;
- Prioritize those sites in five groups: a) the top 10; b) the top 50; c) the top 100; d) the top 150; and e) the remaining sites;
- Provide the scientific/technical justification for the site choices, based on a scientific rationale that considers the needs for seismic data to address issues of near-source recordings in active seismic zones, proximity to critical facilities, improved seismic detection and catalog threshold, uniform coverage, and the needs of the solid earth community; and
- Identify any enhancement to standard TA instrumentation that would be critical for meeting these scientific and technical needs.

Scientific Factors and Approaches to Station Selection

The Transportable Array Station Selection Working Group (TASSWG) was formed in February, 2012 and met weekly via conference call thru March and April, 2012 to provide scientific justification and strategies for selecting 250 TA stations in the central and eastern United States. While the charge specifically requested station prioritization of the top 10, 50, 100, 150 and the remaining stations totaling 250, the TASSWG choose a modification of the charge that prioritizes the stations in groups of 25 stations. The working group prioritized the first 100 stations in 4 groups and then provides a list of an additional 100 stations. It was felt that identifying the remaining 50 stations, for a total of 250 stations, could be reserved for later to allow program managers in the USGS Earthquake Hazards Program, National Science Foundation and the U.S. Nuclear Regulatory Commission flexibility in selecting additional stations that might meet other scientific and administrative goals not articulated in the charge or to account for uncertainties in redeployment, permitting and costs that are not known to the working group. In addition, TA stations in close proximity to existing stations might exceed performance metrics of existing stations in the region, justifying closing or moving the existing station to meet other monitoring requirements or simply reassign the support for permanent operation to that station. While the TASSWG identified particular stations, the Land Use agreements with private Landowners may, in some cases, not be extended which will prompt the managers to choose a nearby station where appropriate.

The TASSWG considered the following key scientific factors in selecting stations:

- Distribution of TA stations within regions of elevated seismic hazards for better source characterization of expected significant earthquakes, recording of nearfield on-scale ground motions, and for better characterization of known seismogenic structures,

- Proximity of TA stations to critical facilities (primarily operating nuclear power plants regulated by NRC and Department of Energy facilities) with an emphasis on critical facilities in areas of higher seismic hazards in order to address issues of near-facility propagation and attenuation, and
- Distribution of TA stations across the CEUS for improved areal coverage in order to lower the overall detection threshold for the region, to identify additional seismogenic structures, for research on regional seismic wave propagation and attenuation, and for improved imaging of the continental crustal and upper mantle.

Selection of priority TA stations was also done in consideration of existing high-quality CEUS broadband stations, and using the catalog of earthquake seismicity recently developed by a joint DOE/EPRI/NRC project to characterize seismic sources in the central and eastern U.S.[2]. The working group attempted to find TA stations that addressed the above scientific factors without being redundant with existing stations. No TA stations were selected that were within 50 km of an existing high-quality broadband station in the CEUS. The seismicity catalog served the role of helping to identify candidate stations near seismic sources or source zones that are not easily identified in the National Seismic Hazard Map.

Initial consideration was given to stations in areas of elevated seismic hazards that lacked existing seismic monitoring and stations close to NRC and DOE critical facilities. Further consideration was given to improved areal distribution of stations throughout the region.

National Seismic Hazards Map

Figure 1 shows the 2008 version of the National Seismic Hazard Map (NSHM) of the United States (peak ground accelerations with 2% probability of being exceeded in 50 years). This map was used as the basis for prioritizing stations within elevated areas of seismic hazards as it encapsulates current knowledge about location and size of past earthquakes and the probabilities of future earthquakes expressed through regional ground motion scaling models. Also shown for reference on the map are the locations of critical facilities used in this evaluation.

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[2] NRC (2011), “Central and Eastern United States Seismic Source Characterization for Nuclear Facilities,” Nuclear Regulatory Commission NUREG 2115. Also published as Department of Energy Report DOE/NE-0140.

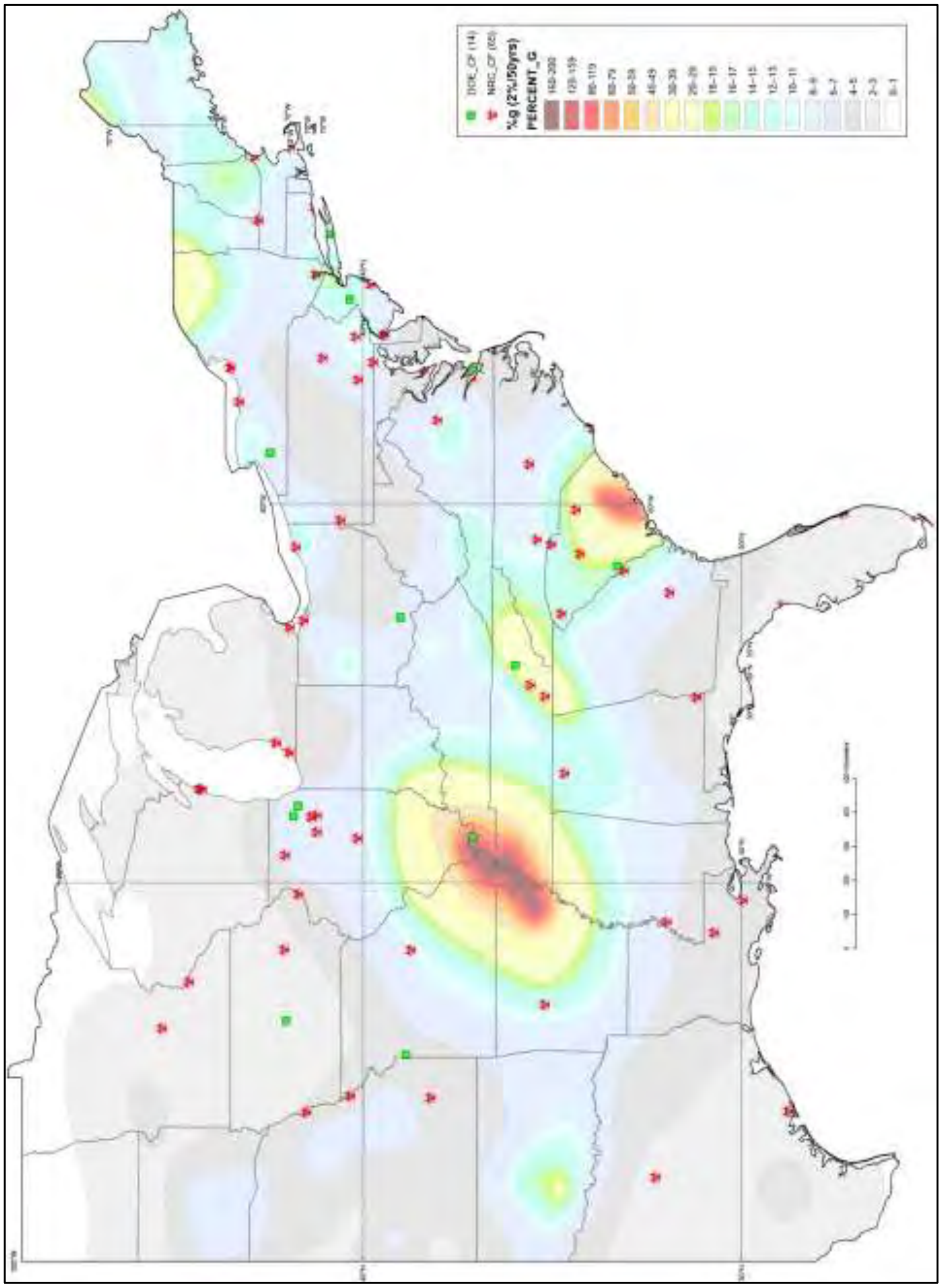

Figure 1: The USGS National Seismic Hazard Map (NSHM) showing the peak ground accelerations with 2% probability of being exceeded in 50 years. The symbols show the location of critical facilities regulated by the US NRC or operated by the DOE.

Selected TA Stations: 1 thru 25

Figure 2 shows the location of the first 25 TA stations selected by the TASSWG. The locations of these TA stations are shown relative to the seismic hazards, NRC and DOE critical facilities, existing permanent seismic stations, and the complete TA station footprint. These initial 25 stations are distributed throughout much of the CEUS, primarily providing new stations in areas of elevated hazards that have not been traditionally monitored (e.g. Charlevoix Source Zone (SZ) of northern Maine, Anna, Ohio SZ and Central Virginia SZ). In addition, this selection of stations also significantly improves the overall areal distribution of seismic stations within the CEUS.

For all TA stations recommended in this report, we used the 8-10%g hazard contour as the minimum criteria for justifying the addition of strong motion sensors to individual stations. TA stations have been identified for upgrades based on the expectation of having large ground motions at the station during its operational lifetime. This is not significant design enhancement, since EarthScope already has experience with these types of upgrades to existing TA stations in Cascadia and other regions.

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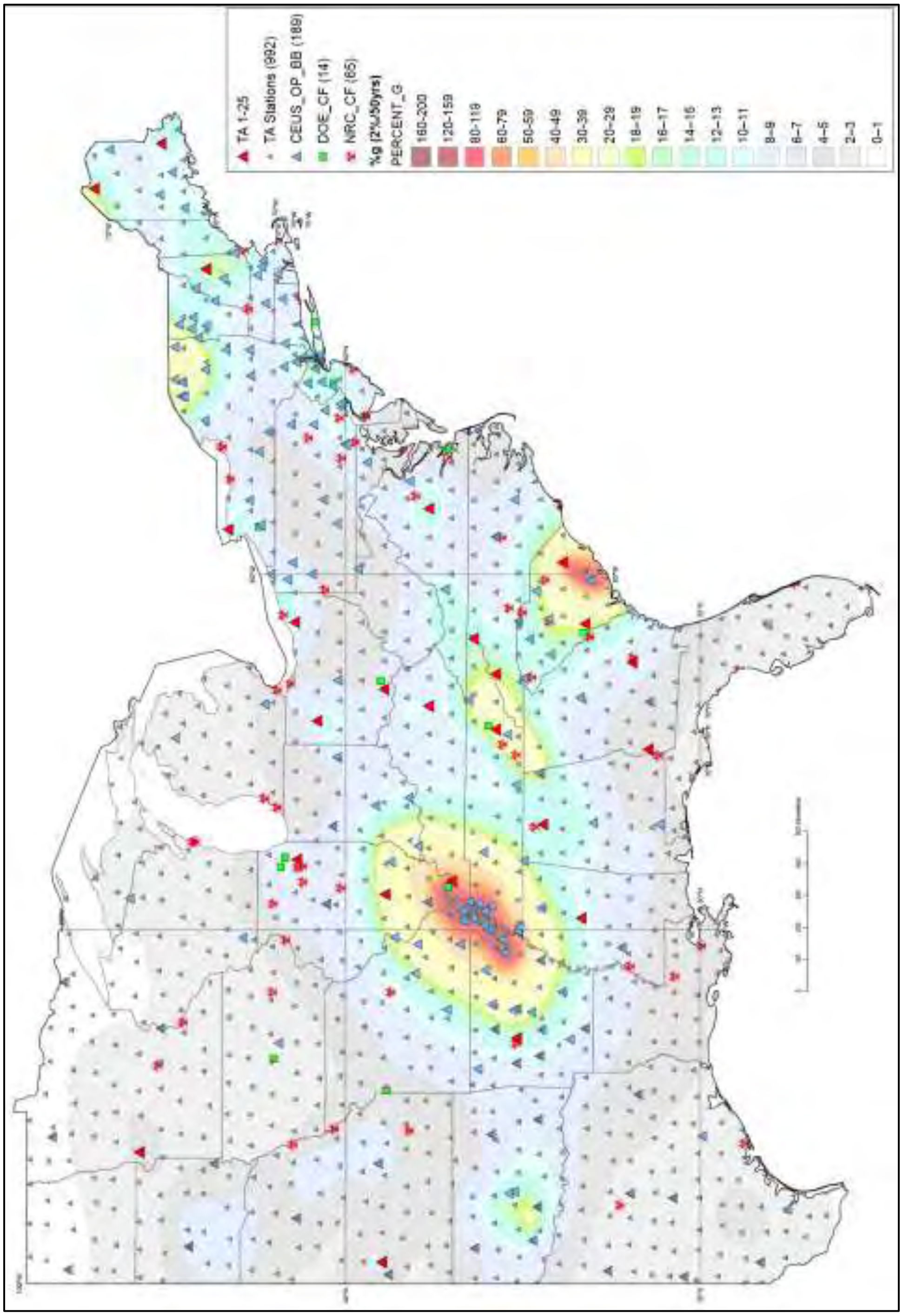

Figure 2: Map shows the location of the first 25 planned TA stations (red triangles) relative to seismic hazards and NRC and DOE critical facilities. These 25 TA stations are also shown in relation to the complete TA footprint and currently operating ANSS stations.

A summary table below provides details on how these 25 planned TA stations compare to the key scientific selection factors. Results show that

- 12 of this group of 25 planned TA stations satisfy the need for seismic stations near (within 75 km) of critical facilities (10, NRC NPP; 5 DOE; stations M44A, Z56A and V51A are close to both NRC NPP and DOE facilities)
- 60% of selected TA stations improve regional coverage,
- 88% of the stations improve coverage of CEUS seismic source zones or regions of elevated seismic hazards, which includes new stations in Central New Hampshire Seismic Zone (SZ), Charlevoix SZ, Charleston SZ, Eastern Tennessee SZ, New Madrid SZ, and elevated seismic hazards in northeast Ohio and eastern Maine, and
- 19 stations require upgrading to include strong motion sensors.

Distribution of planned TA stations 1-25 relative to key scientific selection factors

Stations	NRC	DOE	SSZ	Regional	Closed	Open	Pending	SM
1-25	10	5	22	15	1	9	15	19

Selected TA Stations: 26 thru 50

Figure 3 shows the location of the second group of 25 TA stations selected by the TASSWG. Like the initial 25 planned stations, this group of 25 stations significantly improves seismic monitoring of active source zones through densification of seismic stations within seismic source zones, which lowers the overall detection threshold for better seismotectonic characterization of active seismic structures. A significant number of planned stations are located near additional critical facilities. Overall, this group of stations further improves monitoring of known seismic source zones and expands areal coverage throughout the CEUS.

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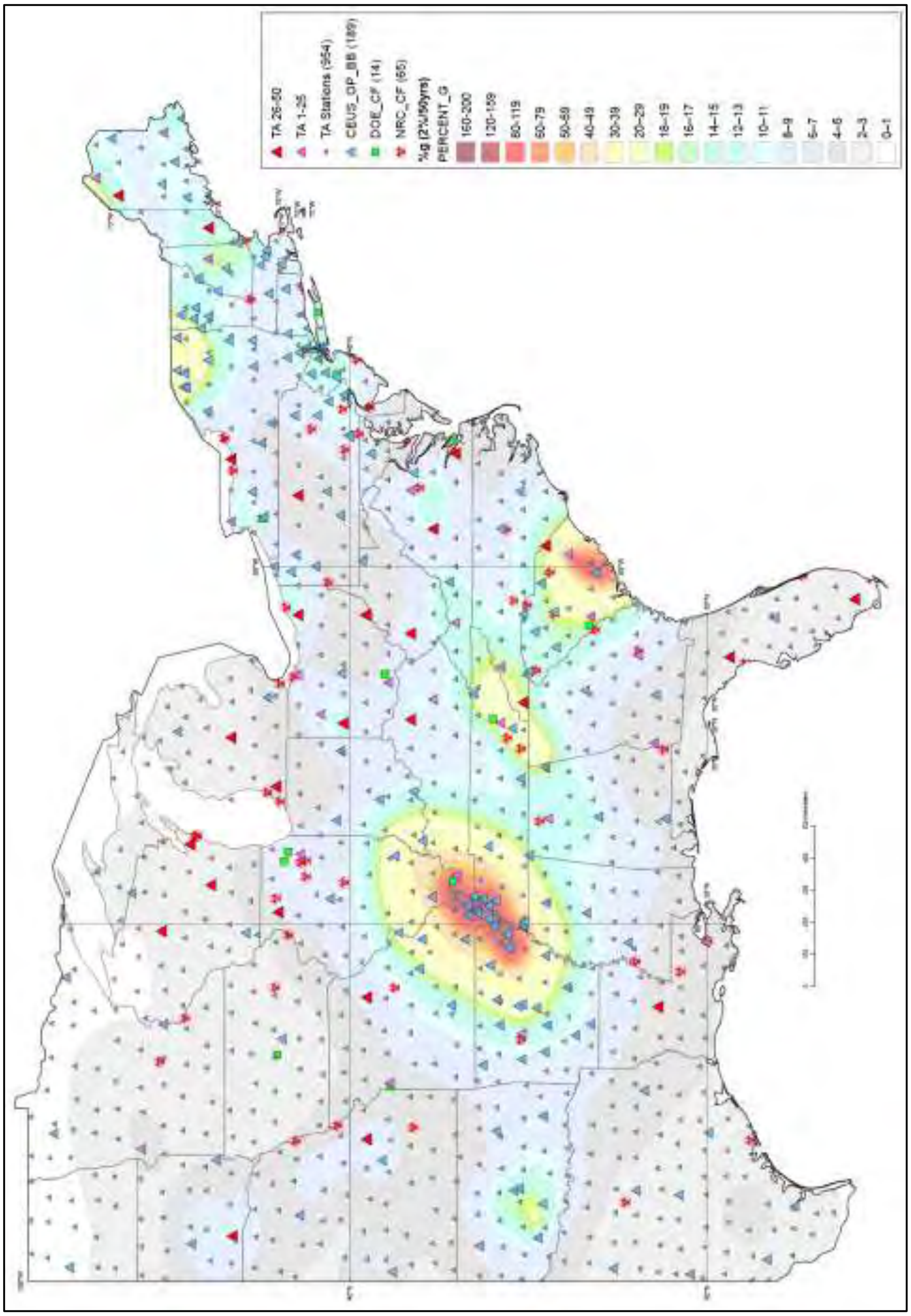

Figure 3: Map shows the location of the second group of 25 planned TA stations (large red triangles) relative to seismic hazards and NRC and DOE critical facilities. This group of 25 selected TA stations is also shown in relation to the initial group of 25 selected TA stations (purple triangles), the complete TA station footprint and currently operating ANSS stations.

A summary table below provides details on how the 2nd group of 25 planned TA stations compare to the key scientific selection factors. Results show that

- 8 of the 2nd group of 25 planned TA stations satisfy the need for seismic stations near (within 75 km) of critical facilities (8, NRC NPP; 1 DOE; station T60A is close to both a NRC NPP and DOE facility),
- 76% of selected TA stations provide improved regional coverage, and
- 52% of the stations improve coverage of CEUS seismic source zones or regions of elevated seismic hazards, which includes new stations in Central New Hampshire Seismic Zone (SZ), Central Virginia SZ, Charlevoix SZ, Charleston SZ, Eastern Tennessee SZ, Anna Ohio SZ, Sharpsville, Kentucky SZ, and elevated seismic hazards in eastern Kansas (Nemeha Ridge), northern Illinois, and eastern Maine, and
- 9 stations require upgrading to include strong motion sensors

Distribution of planned TA stations 26-50 relative to key scientific selection factors

Stations	NRC	DOE	SSZ	Regional	Closed	Open	Pending	SM
26-50	8	1	13	19	2	5	18	9

Selected TA Stations: 51 thru 75

Figure 4 shows the location of the third group of 25 TA stations selected by the TASSWG. With this group of stations, fewer critical facilities have stations within close proximity, but a significant number of planned stations further improve coverage of CEUS seismic source zones. Improved areal coverage is addressed through a broad region of the CEUS, in particular, addition of seismic stations in the upper Midwest and southeastern U.S.

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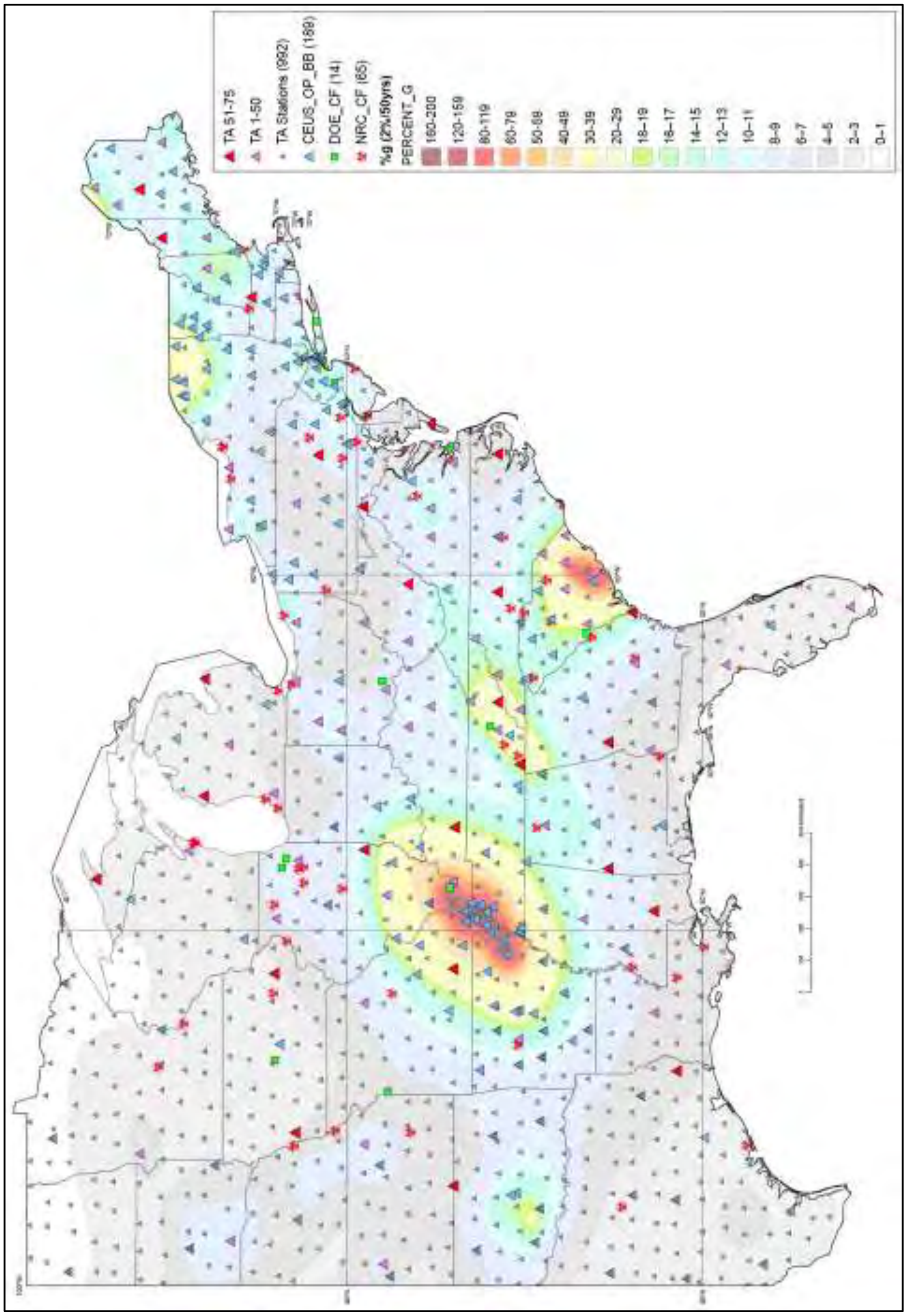

Figure 4: Map shows the location of the third 25 planned TA stations (large red triangles) relative to seismic hazards and NRC and DOE critical facilities. This group of 25 TA stations is also shown in relation to the previously planned 50 TA stations (purple triangles), the complete TA station footprint and currently operating ANSS stations.

A summary table below provides details on how the third group of 25 planned TA stations compare to the key scientific selection factors. Results show that

- 5 of the third group of 25 planned TA stations satisfy the need for seismic stations near (within 75 km) of critical facilities (5, NRC NPP; 0 DOE),
- 84% of selected TA stations improve regional coverage,
- 32% of the stations improve coverage of CEUS seismic source zones or regions of elevated seismic hazards, which includes new stations in Charleston SZ, Eastern Tennessee SZ and New Madrid SZ, and
- 11 stations require upgrading to include strong motion sensors.

Distribution of planned TA stations 51-75 relative to key scientific selection factors

Stations	NRC	DOE	SSZ	Regional	Closed	Open	Pending	SM
51-75	5	0	8	21	2	10	13	11

Selected TA Stations: 76 thru 100

Figure 5 shows the location of the fourth group of 25 TA stations selected by the TASSWG. This group of stations, in combination with the previously planned 75 stations, provides uniformity of seismic stations throughout the entire region. This uniformity of stations, along with densification of seismic monitoring in active source zones, ensures lowering the detection threshold of earthquakes, significantly reduces earthquake location errors over the entire region of the CEUS, and ensures near-source on-scale recording of potentially significant earthquakes through the CEUS.

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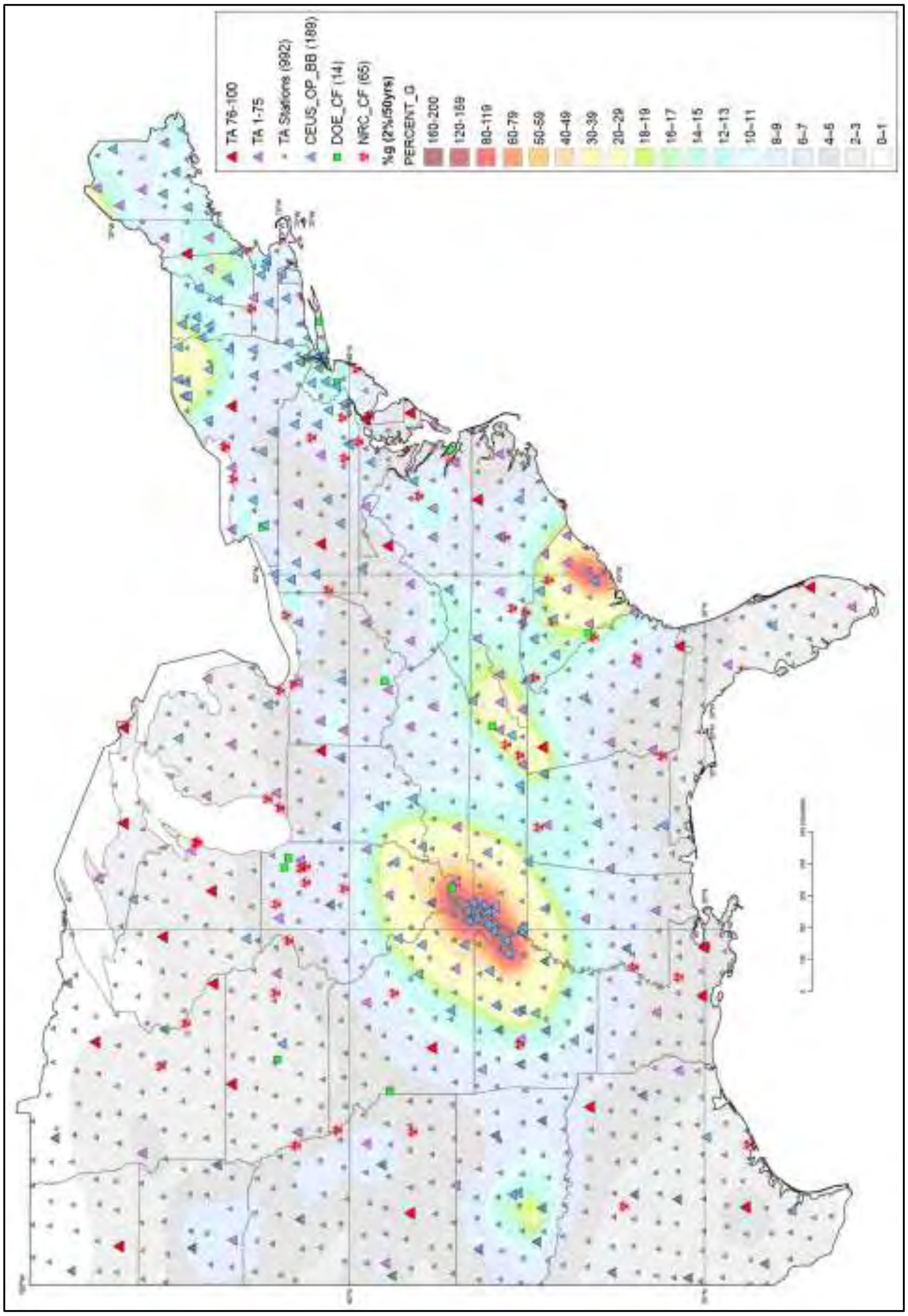

Figure 5: Map shows the location of the fourth group of 25 planned TA stations (large red triangles) relative to seismic hazards and NRC and DOE critical facilities. This group of 25 planned TA stations is also shown in relation to the previously planned 75 TA stations (purple triangles), the complete TA station footprint and currently operating ANSS stations.

A summary table provides details on how the fourth group of 25 planned TA stations compare to the key scientific selection factors. Results show that

- 3 of the fourth group of 25 planned TA stations satisfy the need for seismic stations near (within 75 km) of critical facilities (3, NRC NPP; 0 DOE),
- 88% of selected TA stations improve regional coverage,
- 16% of the stations improve coverage of CEUS seismic source zones or regions of elevated seismic hazards, which includes new stations in Eastern Tennessee SZ, New Madrid SZ, New Brunswick SZ and elevated seismic hazards in upstate New York and east Texas, and
- 5 stations require upgrading to include strong motion sensors.

Distribution of planned TA stations 76-100 relative to key scientific selection factors

Stations	NRC	DOE	SSZ	Regional	Closed	Open	Pending	SM
76-100	3	0	4	22	4	12	9	5

Selected TA Stations: 101 thru 200

Figure 6 shows the location of the fifth group of 100 TA stations selected by the TASSWG. Planned TA stations are shown relative to the seismic hazards, the location of critical facilities, existing permanent seismic stations, temporary TA stations and previously planned 100 TA stations.

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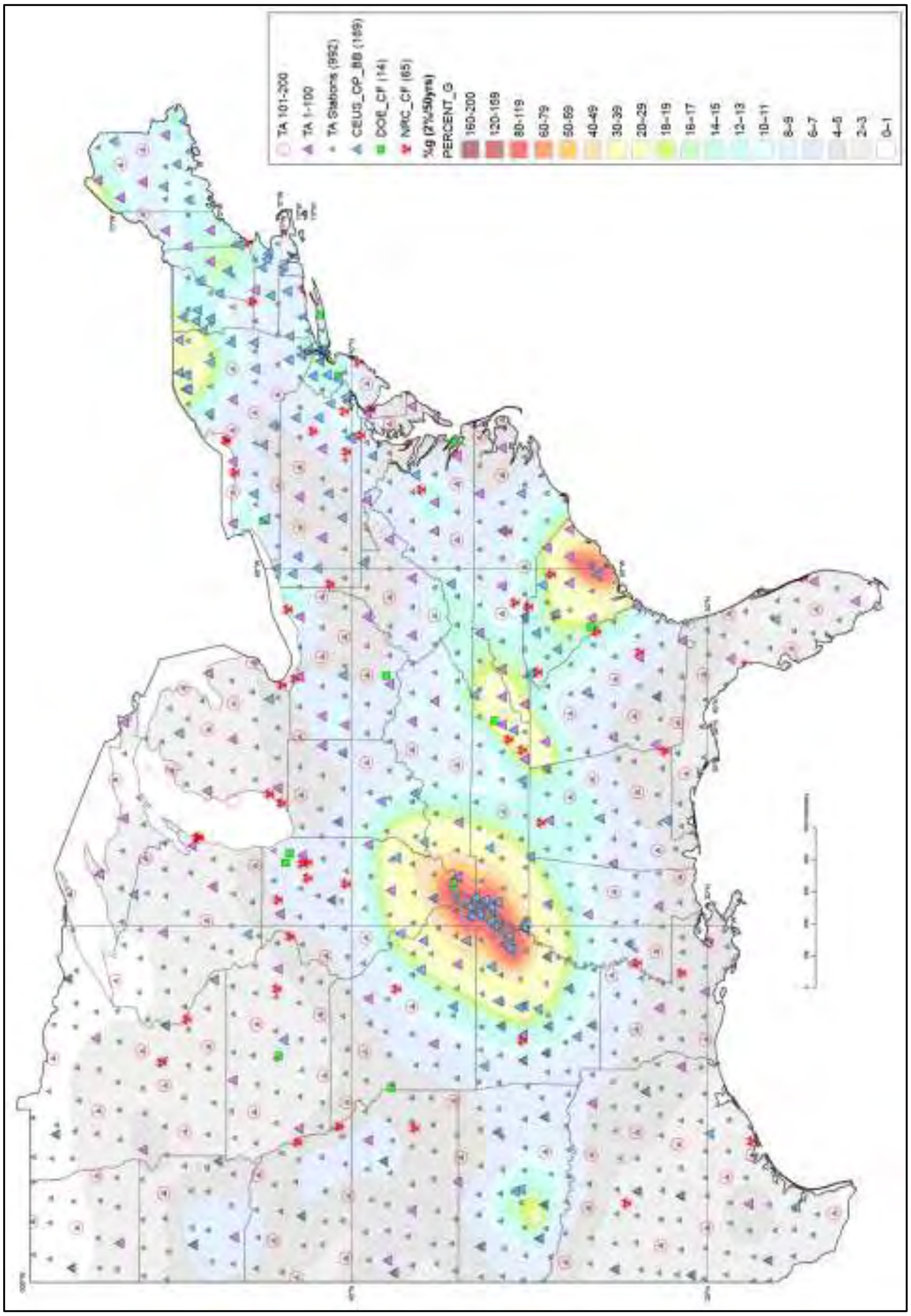

Figure 6: Map shows the location of the fifth group of 100 planned TA stations (red open circles) relative to seismic hazards, critical facilities, existing permanent seismic stations and the previously planned 100 selected TA stations (purple triangles). The map legend describes the symbols and hazard contours.

The map shows that the 200 selected TA stations provide uniform coverage for most of the central and eastern United States, with significantly denser coverage from approximately 80°W to the tip of Maine. This is primarily due to decreasing land area in the eastern most United States and denser existing seismic networks deployed around active source zones in the New England region. The additional TA stations both improve coverage of zones of evaluate seismic hazards, but significantly improve areal coverage in Midwest portion of the central and eastern United States.

A summary table provides details on how the fifth group of 100 planned TA stations compare to the key scientific selection factors. Results show that

- 3 of the fifth group of 100 planned TA stations satisfy the need for seismic stations near (within 75 km) of critical facilities (3, NRC NPP; 0 DOE),
- 100% of selected TA stations improve regional coverage,
- 16% of the stations improve coverage of CEUS seismic source zones or regions of elevated seismic hazards, and
- 18 stations require upgrading to include strong motion sensors.

Distribution of planned TA stations 101-200 relative to key scientific selection factors

Stations	**NRC**	**DOE**	**SSZ**	**Regional**	**Closed**	**Open**	**Pending**	**SM**
101-200	3	0	16	100	20	43	37	18

Summary and Recommendations

Table 1 provides details on 200 TA selected stations, in terms of their proximity to elevated seismic hazards, critical facilities, satisfying regional coverage and recommendations on sensor types. The stations where prioritized in rankings of 1-5, with 1 being the highest priority group of stations and 5 the lowest priority group of stations.

The Transportable Array Station Selection working group took great care in prioritizing the selection of the first 100 TA stations (Ranks 1 through 4; Table 1) based on their contribution to provide important new seismic data for addressing near source seismic hazards issues, near critical facility seismic propagation and attenuation issues and to provide better uniform station coverage needed for research in solid earth geophysics, and to better constrain regional seismotectonics.

The additional 100 (Rank 5) stations are also fundamentally important because they ensure a sufficient density of stations to improve the earth science community's ability to fundamentally reduce uncertainties in seismic hazards assessment in the central and eastern United States, and to improve our knowledge of the constitutive properties and attenuation of the crust and upper mantle structure necessary for understanding the geologic evolution of North America.

This list of 200 stations represents a prioritized strategy for adoption of TA stations that meets the articulated scientific and operational objectives. The working group recognizes that uncertainties exist in the relative quality of individual stations, long-term operational costs, and other factors that might hinder adoption of individual stations. Consequently, it is likely that some flexibility is necessary in choosing alternate stations.

Based on TASS working group discussions and the list of 200 selected stations, the TASS working group recommends to USGS, NSF and other federal agency administrators involved in this implementation the following:

- Act quickly on adopting TA stations that are on the trailing edge of the current deployment in order to minimize re-site and re-permitting costs.
- Upgrade 62 planned TA stations, to include strong motion sensors and 3 additional digital recording channels. We used the 8-10%g hazard contour as the minimum criteria for recording strong motion channels. TA stations have been identified for upgrades based on the expectation of having large ground motions at the station during its operational lifetime. TA stations in Cascadia and other regions already incorporate this enhancement, so it is not a design or development issue.
- As a minimum, continuously sample broadband channels (weak motion sensors) at 100 samples per second (sps), and sample triggered strong motion channels at 200 sps.
- Consider adding strong motion recorders to additional TA stations, those that are within 50 km of previously documented M4.5 or larger earthquakes (see NRC 2011 report) but are not represented as elevated seismic hazards (Figure 1: hazard range of 8-10%g or larger).
- Consider redeploying existing stations (e.g. USGS-supported stations) to meet specific program monitoring goals, if the TA adoption has not or cannot address those program priorities, or if TA stations can perform those functions better.
- Approximately potential future 50 TA station locations are left unspecified by name and location, to allow USGS, NSF and other federal agency program managers flexibility to address potential program priorities not articulated in the working group charge or to buffer against contingencies unknown at this time.

The adoption of a large number of TA stations, which are integrated into existing real-time network operations and waveform archives, represents a unique, highly-leveraged investment that will reduce uncertainties in hazard assessments and to advance our understanding of North America geologic structure and evolution.

Unfortunately, these planned stations cannot address all seismic hazards related issues at the limited number of critical facilities considered by the working group. To further promote this comprehensive and integrated approach to seismic data collection, monitoring and product distribution, the working group encourages federal program managers to develop a strategy to seek voluntary installation of modern sensor systems at a broad range of CEUS critical facilities whose data could be integrated easily in network operations and which would contribute significantly to earthquake-associated risk reduction.

Table 1: Summary of selected TA stations by facility, hazard and areal coverage

Stations	NRC	DOE	SSZ	Regional	Closed	Open	Pending	SM
1-25	10	5	22	15	1	9	15	19
26-50	8	1	13	19	2	5	18	9
51-75	5	0	8	21	2	10	13	11
76-100	3	0	4	22	4	12	9	5
101-200	3	0	16	100	20	43	37	18

Table 2: Summary of selected TA stations by State

State	No. of Stations
Alabama	6
Arkansas	1
Delaware	1
Florida	9
Georgia	9
Iowa	7
Illinois	6
Indiana	3
Kansas	5
Kentucky	6
Louisiana	6
Maryland	2
Massachusetts	1
Maine	10
Michigan	15
Minnesota	9
Missouri	6
Mississippi	5
North Carolina	11
North Dakota	4
Nebraska	5
New Hampshire	1
New Jersey	1
New York	9
Ohio	11
Oklahoma	2
Pennsylvania	5
South Carolina	5
South Dakota	2
Tennessee	5
Texas	13
Virginia	6
Wisconsin	7
West Virginia	6

Table 3: Prioritized 200 selected TA stations

Station	Lat.	Long.	CF	Hazard	Sensors	SSZ	Regional	State	Status	Rank
Q31A	39	-99.39		6-8	BB	✓		KS	Closed	1
X48A	34.45	-87.05	NPP	12-14	BB/SM	✓	✓	AL	Open	1
W40A	35.19	-93.07	NPP	14-16	BB/SM	✓		AR	Open	1
255A	31.93	-82.48	NPP	6-8	BB		✓	GA	Open	1
352A	31.48	-84.93	NPP	4-6	BB		✓	GA	Open	1
M44A	41.39	-88.04	NPP/DOE	6-8	BB		✓	IL	Open	1
Q44A	38.9	-89.02		20-30	BB/SM	✓		IL	Open	1
T45A	37.02	-88.64	DOE	60-80	BB/SM	✓		KY	Open	1
F33A	45.84	-96.29		4-6	BB	✓	✓	MN	Open	1
Z45A	33.37	-89.69		12-14	BB/SM	✓	✓	MS	Open	1
S51A	37.67	-83.71		8-10	BB/SM	✓	✓	KY	Pending	1
D62A	47.11	-69.12		16-18	BB/SM	✓	✓	ME	Pending	1
G65A	45.22	-67.85		12-18	BB/SM	✓	✓	ME	Pending	1
V53A	35.78	-82.81		18-20	BB/SM	✓	✓	NC	Pending	1
Y60A	33.89	-78.14	NPP	12-14	BB/SM	✓	✓	NC	Pending	1
I62A	43.96	-71.39		16-18	BB/SM	✓		NH	Pending	1
J54A	43.33	-78.73		10-12	BB/SM	✓		NY	Pending	1
M52A	41.45	-81.35	NPP	10-12	BB/SM	✓	✓	OH	Pending	1
N49A	40.82	-84.13		8-10	BB/SM	✓	✓	OH	Pending	1
Q51A	38.93	-83.24	DOE	6-8	BB	✓	✓	OH	Pending	1
Y58A	33.89	-79.66		50-60	BB/SM	✓		SC	Pending	1
Z56A	33.26	-81.39	NPP/DOE	20-30	BB/SM	✓		SC	Pending	1
U54A	36.41	-81.81		14-16	BB/SM	✓	✓	TN	Pending	1
V51A	35.78	-84.37	NPP/DOE	20-30	BB/SM	✓		TN	Pending	1
S58A	37.67	-78.14	NPP	14-16	BB/SM	✓		VA	Pending	1
P35A	39.53	-96.02		6-8	BB	✓		KS	Closed	2
J31A	43.29	-98.74		6-8	BB	✓	✓	SD	Closed	2
656A	29.37	-82.53	NPP	2-4	BB		✓	FL	Open	2
L42A	42	-89.67	NPP	6-8	BB	✓	✓	IL	Open	2
342A	31.37	-92.32		4-6	BB		✓	LA	Open	2
P40A	39.53	-92.05		6-8	BB		✓	MO	Open	2
H43A	44.47	-87.77	NPP	2-4	BB		✓	WI	Open	2
061Z	25.87	-80.91	NPP	2-4	BB		✓	FL	Pending	2
R50A	38.3	-84.28		8-10	BB/SM	✓	✓	KY	Pending	2
E62A	46.48	-69.61		12-14	BB/SM	✓	✓	ME	Pending	2
I63A	43.96	-70.52		14-16	BB/SM	✓	✓	ME	Pending	2
J47A	43.33	-84.78		2-4	BB		✓	MI	Pending	2
L46A	42.07	-86.15	NPP	4-6	BB		✓	MI	Pending	2
W52A	35.15	-83.80		20-30	BB/SM	✓		NC	Pending	2
M50A	41.45	-83.03	NPP	6-8	BB	✓	✓	OH	Pending	2
O49A	40.19	-84.38		10-12	BB/SM	✓		OH	Pending	2

P53A	39.56	-81.35		4-6	BB		✓	OH	Pending	2
M56A	41.45	-78.00		4-6	BB		✓	PA	Pending	2
X58A	34.52	-79.42		20-30	BB/SM	✓		SC	Pending	2
Y57A	33.89	-80.41		30-40	BB/SM	✓		SC	Pending	2
Y59A	33.89	-78.90		20-30	BB/SM	✓		SC	Pending	2
S57A	37.67	-78.94		10-12	BB/SM	✓	✓	VA	Pending	2
R53A	38.3	-81.87		6-8	BB		✓	WV	Pending	2
J56A	43.33	-76.99	NPP	6-8	BB		✓	NY	Pending	2
T60A	37.04	-76.84	NPP/DOE	4-6	BB		✓	VA	Pending	2
T34A	37.02	-97.19		4-6	BB		✓	KS	Closed	3
440A	30.75	-93.96		4-6	BB		✓	TX	Closed	3
147A	32.67	-88.27		8-10	BB/SM		✓	AL	Open	3
152A	32.67	-84.72		4-6	BB		✓	GA	Open	3
257A	32	-81.06		14-16	BB/SM	✓	✓	GA	Open	3
L40A	42.06	-91.22	NPP	2-4	BB		✓	IA	Open	3
M35A	41.47	-95.69	NPP	2-4	BB		✓	IA	Open	3
P45A	39.53	-87.74		12-14	BB/SM	✓	✓	IL	Open	3
T47A	36.99	-87.11		20-30	BB/SM	✓		KY	Open	3
D41A	47.06	-88.57		2-4	BB		✓	MI	Open	3
T42A	37.03	-91.09		30-40	BB/SM	✓		MO	Open	3
346A	31.39	-89.46		4-6	BB		✓	MS	Open	3
K62A	42.7	-72.20	NPP	8-10	BB/SM		✓	MA	Pending	3
F63A	45.85	-69.17		8-10	BB/SM	✓	✓	ME	Pending	3
G62A	45.22	-70.53		8-10	BB/SM	✓	✓	ME	Pending	3
I45A	44.04	-86.23		2-4	BB		✓	MI	Pending	3
I49A	44.01	-82.93		2-4	BB		✓	MI	Pending	3
V56A	35.78	-80.49		8-10	BB/SM		✓	NC	Pending	3
V61A	35.78	-76.61		4-6	BB		✓	NC	Pending	3
N58A	40.82	-76.64	NPP	6-8	BB		✓	PA	Pending	3
V52A	35.78	-83.59		20-30	BB/SM	✓		TN	Pending	3
W50A	35.15	-85.34	NPP	20-30	BB/SM	✓		TN	Pending	3
S61A	37.67	-75.76		2-4	BB		✓	VA	Pending	3
P57A	39.56	-78.09		6-8	BB		✓	WV	Pending	3
R55A	38.3	-80.27		6-8	BB		✓	WV	Pending	3
R33A	38.31	-97.98		2-4	BB		✓	KS	Closed	4
E30A	46.5	-98.91		2-4	BB		✓	ND	Closed	4
735A	28.86	-97.81		4-6	BB		✓	TX	Closed	4
Z38A	33.25	-94.99		2-4	BB		✓	TX	Closed	4
060A	27.04	-80.36	NPP	2-4	BB		✓	FL	Open	4
456A	30.72	-82.02		4-6	BB		✓	FL	Open	4
X51A	34.57	-84.86		20-30	BB/SM	✓		GA	Open	4
J36A	43.33	-94.34		2-4	BB		✓	IA	Open	4
543A	30.09	-91.86		2-4	BB		✓	LA	Open	4
545A	30.04	-90.49	NPP	4-6	BB		✓	LA	Open	4

E43A	46.38	-87.00		2-4	BB		✓	MI	Open	4
D36A	47.18	-93.16		2-4	BB		✓	MN	Open	4
I39A	43.85	-91.52		2-4	BB		✓	MN	Open	4
S39A	37.69	-93.32		8-10	BB/SM		✓	MO	Open	4
G40A	45.27	-90.20		2-4	BB		✓	WI	Open	4
I42A	43.89	-88.91		2-4	BB		✓	WI	Open	4
N47A	40.82	-84.96		6-8	BB	✓		IN	Pending	4
H62A	44.59	-70.97		12-14	BB/SM		✓	ME	Pending	4
E46A	46.37	-84.31		2-4	BB		✓	MI	Pending	4
U59A	36.41	-77.90		6-8	BB		✓	NC	Pending	4
J58A	43.33	-75.26		8-10	BB/SM	✓	✓	NY	Pending	4
N55A	40.82	-79.14		4-6	BB		✓	PA	Pending	4
Q56A	38.93	-79.19		4-6	BB		✓	WV	Pending	4
P60A	39.56	-75.64	NPP	8-10	BB/SM	✓		DE	Pending	4
R61A	38.3	-75.45		4-6	BB		✓	MD	Pending	4
T37A	37.12	-94.92		4-6	BB		✓	KS	Closed	5
O36A	40.13	-94.96		4-6	BB		✓	MO	Closed	5
A30A	48.94	-98.30		0-2	BB		✓	ND	Closed	5
C30A	47.7	-98.48		2-4	BB		✓	ND	Closed	5
L31A	42.18	-98.84		4-6	BB		✓	NE	Closed	5
M30A	41.54	-99.87		2-4	BB		✓	NE	Closed	5
O31A	40.15	-99.33		2-4	BB		✓	NE	Closed	5
O33A	40.08	-97.58		4-6	BB		✓	NE	Closed	5
T35A	36.92	-96.51		4-6	BB		✓	OK	Closed	5
X36A	34.57	-96.35		10-12	BB/SM	✓	✓	OK	Closed	5
035Z	26.46	-98.07		2-4	BB		✓	TX	Closed	5
237A	32	-95.81		4-6	BB		✓	TX	Closed	5
333A	31.32	-98.98		2-4	BB		✓	TX	Closed	5
437A	30.83	-96.14		2-4	BB		✓	TX	Closed	5
534A	30.03	-98.48		2-4	BB		✓	TX	Closed	5
636A	29.48	-97.06		2-4	BB		✓	TX	Closed	5
737A	28.76	-96.44	NPP	2-4	BB		✓	TX	Closed	5
Y32A	34	-99.44		4-6	BB		✓	TX	Closed	5
Z34A	33.37	-97.92		4-6	BB		✓	TX	Closed	5
Z36A	33.27	-96.43		4-6	BB		✓	TX	Closed	5
250A	31.98	-86.27		4-6	BB		✓	AL	Open	5
348A	31.41	-87.90		6-8	BB		✓	AL	Open	5
Y49A	33.86	-86.41		12-14	BB/SM	✓	✓	AL	Open	5
Z50A	33.25	-85.92		8-10	BB/SM	✓	✓	AL	Open	5
059A	26.97	-81.14		2-4	BB		✓	FL	Open	5
451A	30.62	-85.75		2-4	BB		✓	FL	Open	5
555A	30.12	-82.97		4-6	BB		✓	FL	Open	5
658A	29.42	-81.26		4-6	BB		✓	FL	Open	5
154A	32.61	-83.11		6-8	BB		✓	GA	Open	5

253A	32.06	-84.13		4-6	BB		✓	GA	Open	5
453A	30.85	-84.32		4-6	BB		✓	GA	Open	5
Y52A	33.86	-84.06		8-10	BB/SM		✓	GA	Open	5
K35A	42.72	-95.23		2-4	BB		✓	IA	Open	5
K38A	42.65	-92.77		2-4	BB		✓	IA	Open	5
N37A	40.76	-94.21		2-4	BB		✓	IA	Open	5
N39A	40.88	-92.50		4-6	BB		✓	IA	Open	5
N41A	40.71	-90.86		4-6	BB		✓	IL	Open	5
P42A	39.59	-90.34		10-12	BB/SM	✓	✓	IL	Open	5
M46A	41.41	-86.35		4-6	BB		✓	IN	Open	5
143A	32.7	-91.40		8-10	BB/SM	✓	✓	LA	Open	5
241A	32.02	-92.92		4-6	BB		✓	LA	Open	5
541A	30.06	-93.19		4-6	BB		✓	LA	Open	5
C40A	47.92	-89.15		0-2	BB		✓	MI	Open	5
E44A	46.62	-85.92		0-2	BB		✓	MI	Open	5
B35A	48.36	-93.73		0-2	BB		✓	MN	Open	5
D34A	47.09	-95.20		2-4	BB		✓	MN	Open	5
F36A	45.86	-93.52		2-4	BB		✓	MN	Open	5
G35A	45.22	-94.49		2-4	BB		✓	MN	Open	5
H34A	44.67	-95.78		2-4	BB		✓	MN	Open	5
I37A	44.01	-93.40		2-4	BB		✓	MN	Open	5
P38A	39.62	-93.53		2-4	BB		✓	MO	Open	5
R40A	38.29	-92.27		10-12	BB/SM	✓	✓	MO	Open	5
146A	32.64	-89.06		8-10	BB/SM		✓	MS	Open	5
344A	31.45	-90.73		4-6	BB		✓	MS	Open	5
447A	30.8	-88.65		4-6	BB		✓	MS	Open	5
D32A	47.14	-97.02		0-2	BB		✓	ND	Open	5
K33A	42.61	-97.00		4-6	BB		✓	NE	Open	5
G32A	45.26	-97.50		2-4	BB		✓	SD	Open	5
V48A	35.74	-86.82		12-14	BB/SM	✓	✓	TN	Open	5
E38A	46.61	-91.55		0-2	BB		✓	WI	Open	5
F41A	45.76	-88.13		2-4	BB		✓	WI	Open	5
I41A	44.06	-89.87		0-2	BB		✓	WI	Open	5
K43A	42.7	-88.33		4-6	BB		✓	WI	Open	5
957A	27.67	-82.24		2-4	BB		✓	FL	Pending	5
P48A	39.56	-85.44		6-8	BB		✓	IN	Pending	5
R49A	38.3	-85.08		2-4	BB		✓	KY	Pending	5
T49A	37.04	-85.51		8-10	BB/SM		✓	KY	Pending	5
Q60A	38.93	-75.95		4-6	BB		✓	MD	Pending	5
E63A	46.48	-68.69		10-12	BB/SM	✓	✓	ME	Pending	5
F62A	45.85	-70.08		8-10	BB/SM	✓	✓	ME	Pending	5
F64A	45.85	-68.27		8-10	BB/SM	✓	✓	ME	Pending	5
G45A	45.04	-85.66		2-4	BB		✓	MI	Pending	5
H48A	44.71	-83.35		2-4	BB		✓	MI	Pending	5

I47A	44.02	-84.51		2-4	BB		✓	MI	Pending	5
J45A	43.33	-86.52		2-4	BB		✓	MI	Pending	5
J48A	43.3	-83.78		2-4	BB		✓	MI	Pending	5
K50A	42.77	-82.62		2-4	BB		✓	MI	Pending	5
U61A	36.41	-76.33		4-6	BB		✓	NC	Pending	5
V55A	35.78	-81.26		10-12	BB/SM	✓	✓	NC	Pending	5
V60A	35.78	-77.38		4-6	BB		✓	NC	Pending	5
V62A	35.78	-75.83		2-4	BB		✓	NC	Pending	5
W57A	35.15	-79.95		12-14	BB/SM	✓	✓	NC	Pending	5
P61A	39.56	-74.82		4-6	BB		✓	NJ	Pending	5
J55A	43.33	-77.86		6-8	BB		✓	NY	Pending	5
J57A	43.33	-76.13	NPP	6-8	BB		✓	NY	Pending	5
J59A	43.33	-74.40		12-14	BB/SM	✓	✓	NY	Pending	5
K58A	42.7	-75.63		6-8	BB		✓	NY	Pending	5
L56A	42.07	-77.67		4-6	BB		✓	NY	Pending	5
L59A	42.07	-75.13		6-8	BB		✓	NY	Pending	5
M48A	41.45	-84.71		4-6	BB		✓	OH	Pending	5
N51A	40.82	-82.47		4-6	BB		✓	OH	Pending	5
N53A	40.82	-80.80	NPP	6-8	BB	✓	✓	OH	Pending	5
O52A	40.19	-81.91		4-6	BB		✓	OH	Pending	5
P51A	39.56	-82.99		4-6	BB		✓	OH	Pending	5
M55A	41.45	-78.84		4-6	BB		✓	PA	Pending	5
M57A	41.45	-77.16		4-6	BB		✓	PA	Pending	5
T57A	37.04	-79.20		6.8	BB		✓	VA	Pending	5
T59A	37.04	-77.63		8-10	BB/SM	✓	✓	VA	Pending	5
Q54A	38.93	-80.81		4-6	BB		✓	WV	Pending	5
S54A	37.67	-81.32		10-12	BB/SM	✓	✓	WV	Pending	5

Key to Columns Labels:

Station: Station code of selected TA station

Latitude and Longitude: Geographic coordinates of selected TA station

CF: Critical Facility (NPP: Nuclear Power Plant; DOE: Department of Energy)

Hazard: %g of peak ground accelerations with 2% probability of being exceeded in 50 years

SSZ: seismic source zone, named or known region of elevated seismic hazard

Regional: A qualitative description as to whether the station improves regional seismic monitoring coverage. The assessment is primarily based on whether the station is close to an existing station or if the station outside of a seismic source zone that is already extensive monitored.

Status: Operational status of TA station

State: State within which the selected TA station is operating

Sensors: Recommendation of types of sensors to be operated at the selected site (BB/SM: broadband and strong-motion; BB: broadband only)

SSZ: Within a known seismic source zone identified by elevated seismic hazards on the NSHM

Working Group Membership

Name	***Affiliation***
Dr. Harley Benz	U.S. Geological Survey
Dr. Anne Meltzer	Lehigh University
Dr. Brian Stump	Southern Methodist University
Dr. David Spears	Virginia Department of Mines, Minerals and Energy
Dr. Art Frankel	USGS
Dr. Mitch Withers	University of Memphis
Dr. Won-Young Kim	Columbia University
Dr. Robert Herrmann	Saint Louis University
Mr. Robert Busby	Incorporated Research in Seismology (IRIS)
Dr. Robert Woodward	Incorporated Research in Seismology (IRIS)
Dr. Gregory Anderson	National Science Foundation
Dr. Matt Fouch	Carnegie Institution
Dr. Tim Leftwich	Ohio Geological Survey
Dr. Annie Kammerer	United States Nuclear Regulatory Commission
Dr. Mike Hansen	Ohio Geological Survey
Dr. Andrew Murphy	United States Nuclear Regulatory Commission
Dr. Stephen McDuffie	Department of Energy
Mr. Jeffrey Munsey	Tennessee Valley Authority