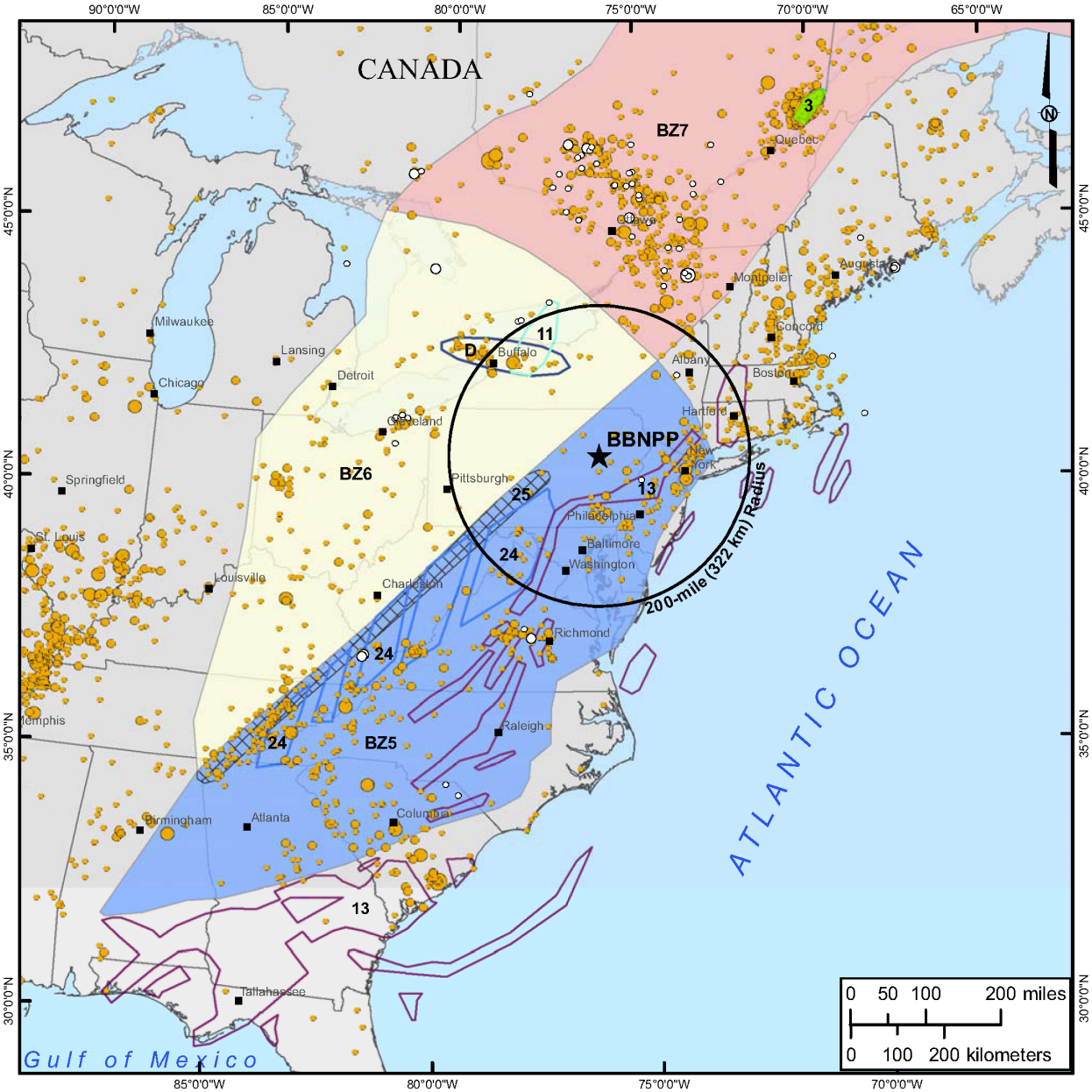
Figure 2.5-19 {Bechtel Group EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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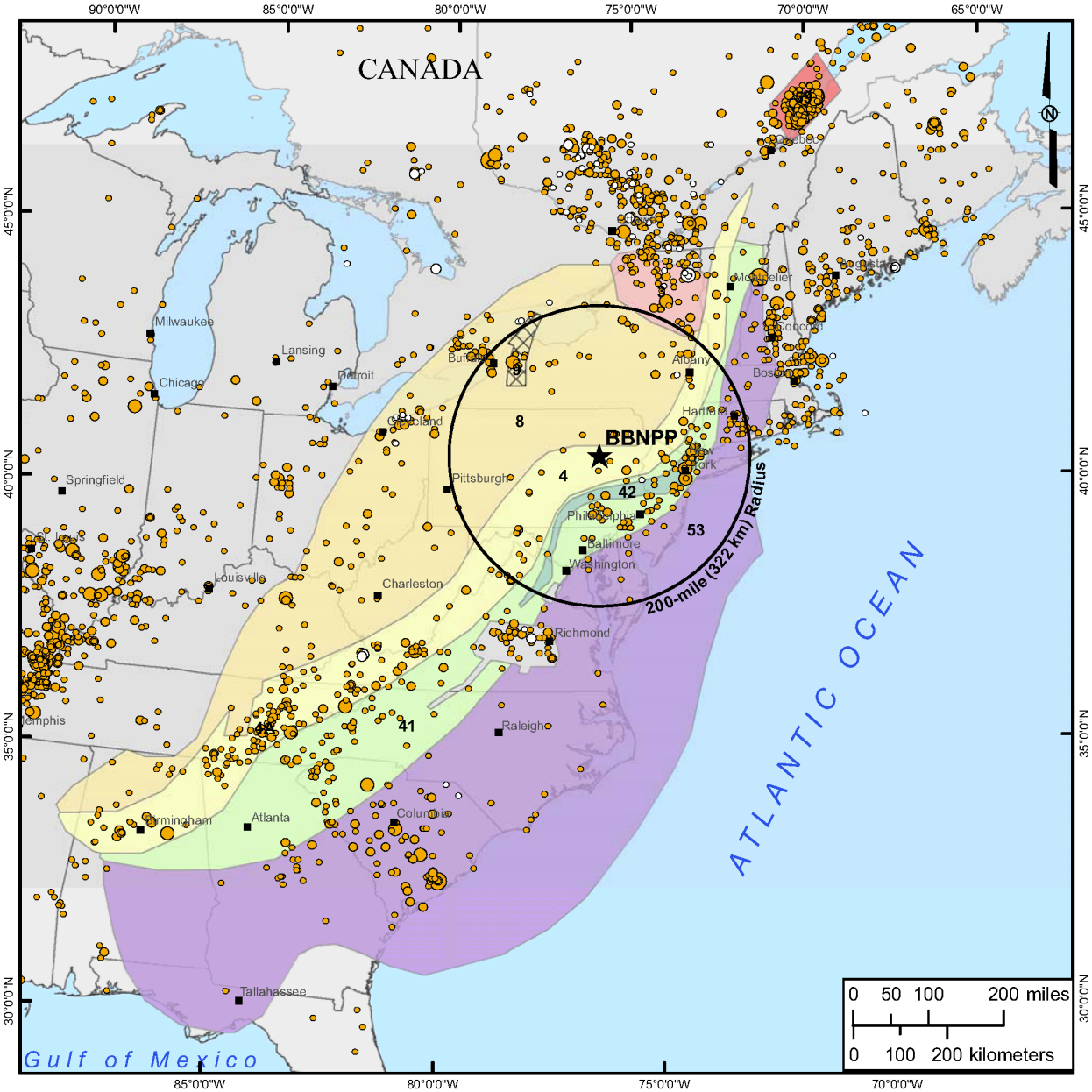
Figure 2.5-20 {Dames & Moore EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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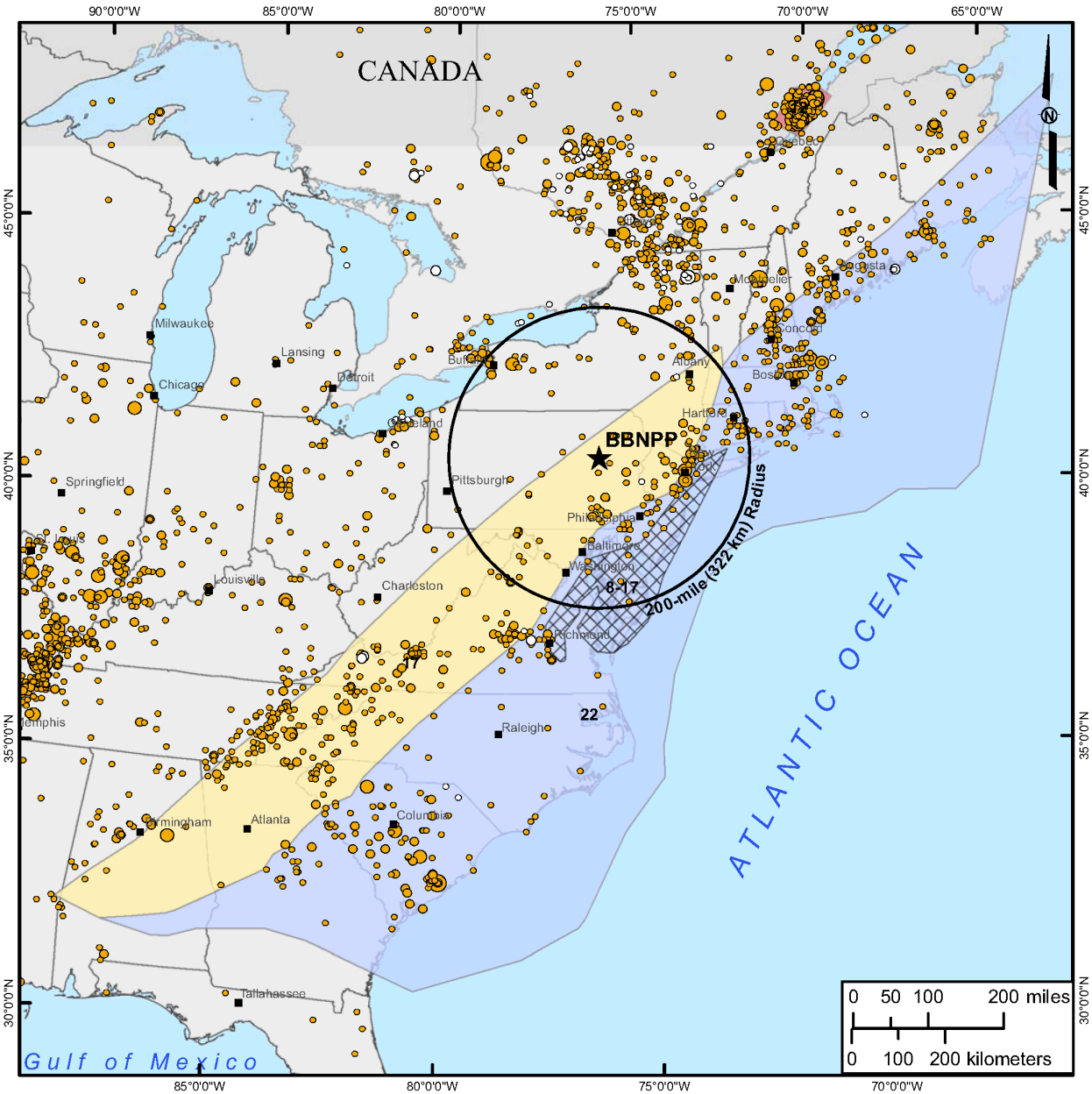
Figure 2.5-21 {Law Engineering EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

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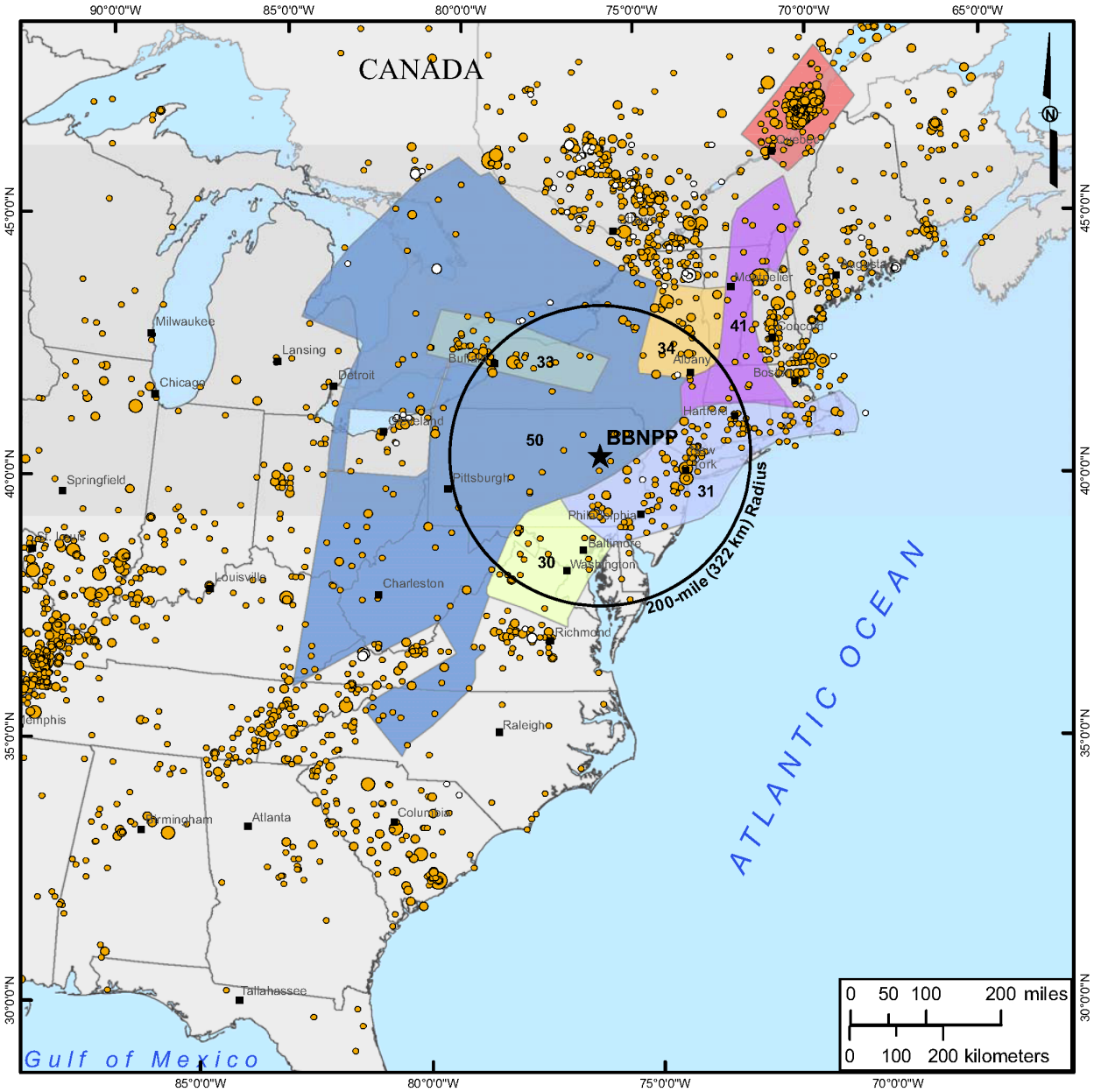
Figure 2.5-22 {Rondout Associates EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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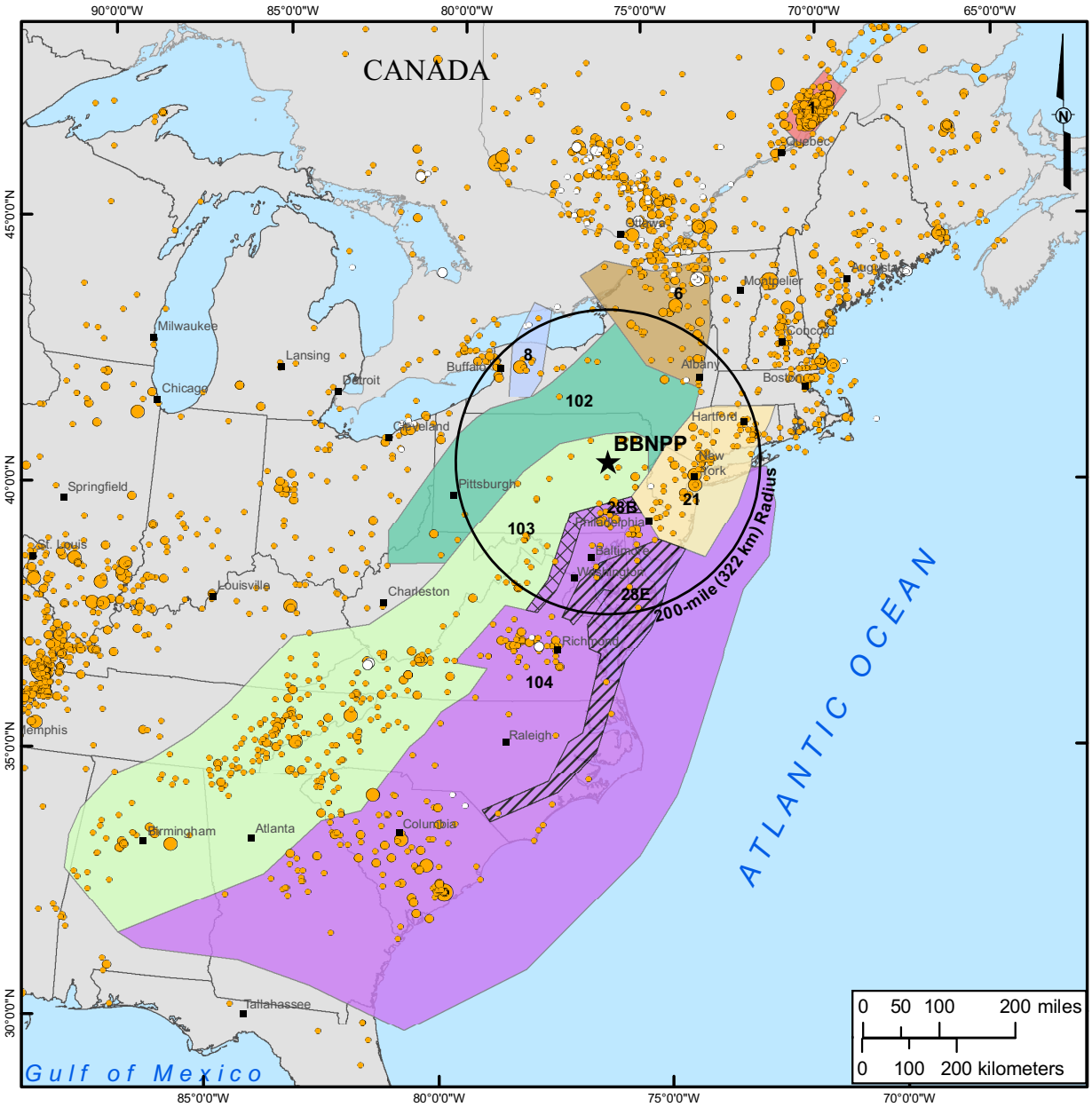
Figure 2.5-23 {Weston Geophysical EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 28B Zone of Mesozoic Basin
- 28E Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

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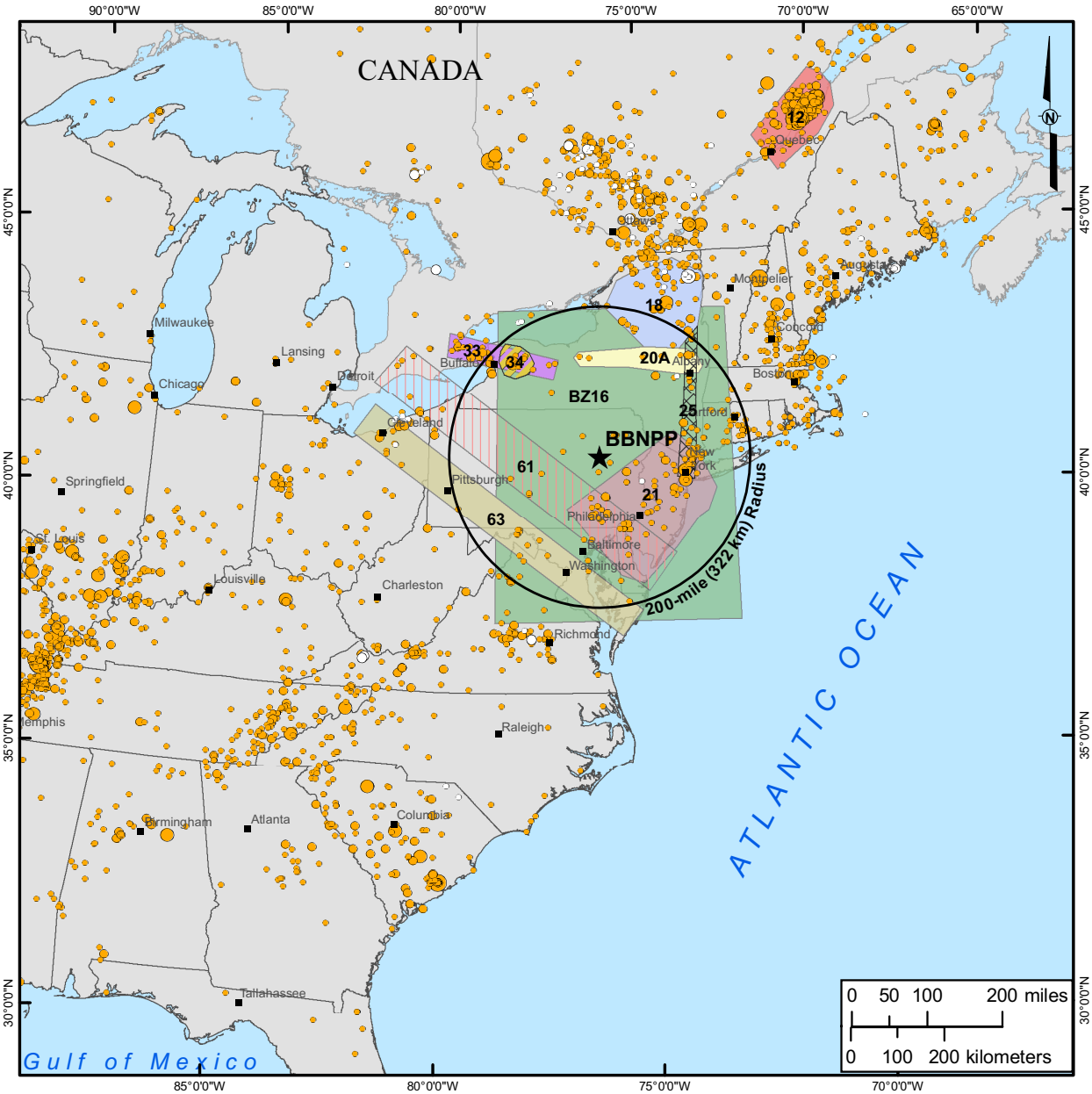
Figure 2.5-24 {Woodward-Clyde Consultants EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 25 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 63 Pittsburgh - Washington Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 61 Tyrone - Mt. Union Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

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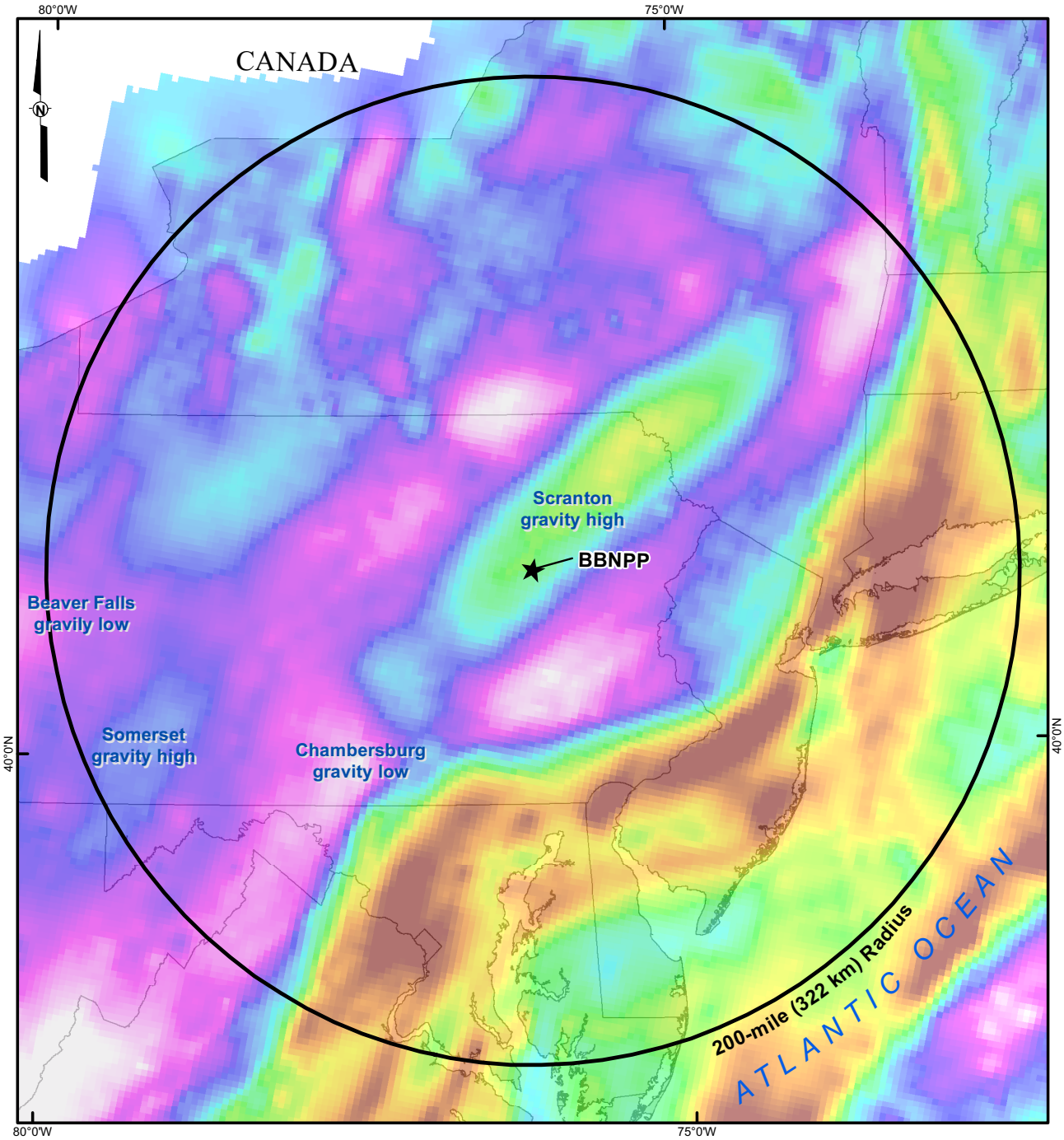
Figure 2.5-25 {Regional Bouguer Gravity Anomaly Map}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 200-mile (322 km) Radius

Gravity Anomaly

0 95 mgals

-340 mgals

0 25 50 100 miles

0 25 50 100 kilometers

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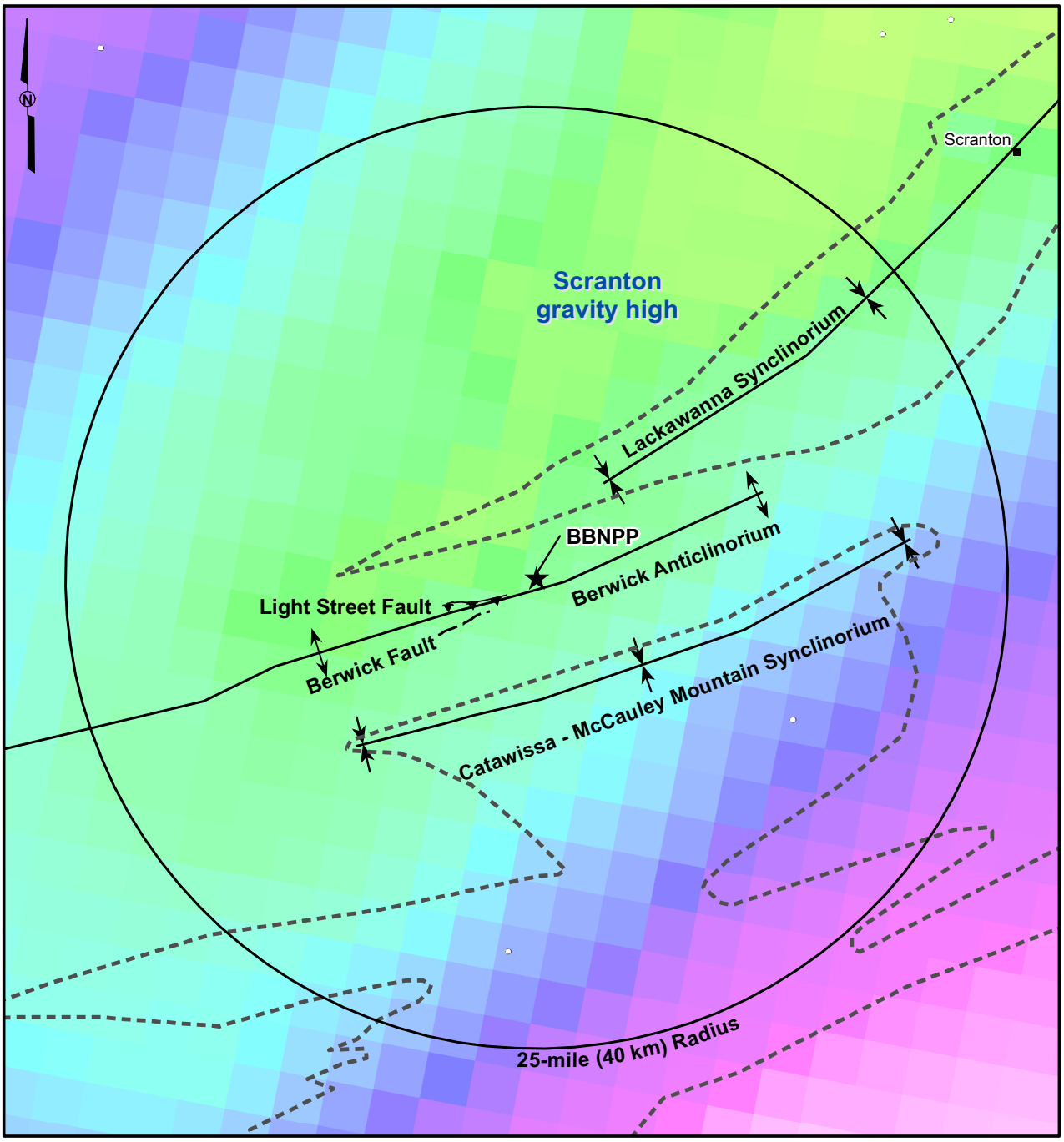
Figure 2.5-26 {Site Vicinity Bouguer Gravity Anomaly Map}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 25-mile (40 km) Radius

— — Anthracite Region

Earthquakes by Magnitude, m_b

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

Gravity Anomaly

0 - 95 mgals

-340 mgals

0 2.5 5 10 miles

0 2.5 5 10 kilometers

REFERENCE:
- Kucks, 1999.
- Harrison, 2004.
- USGS, 2007.

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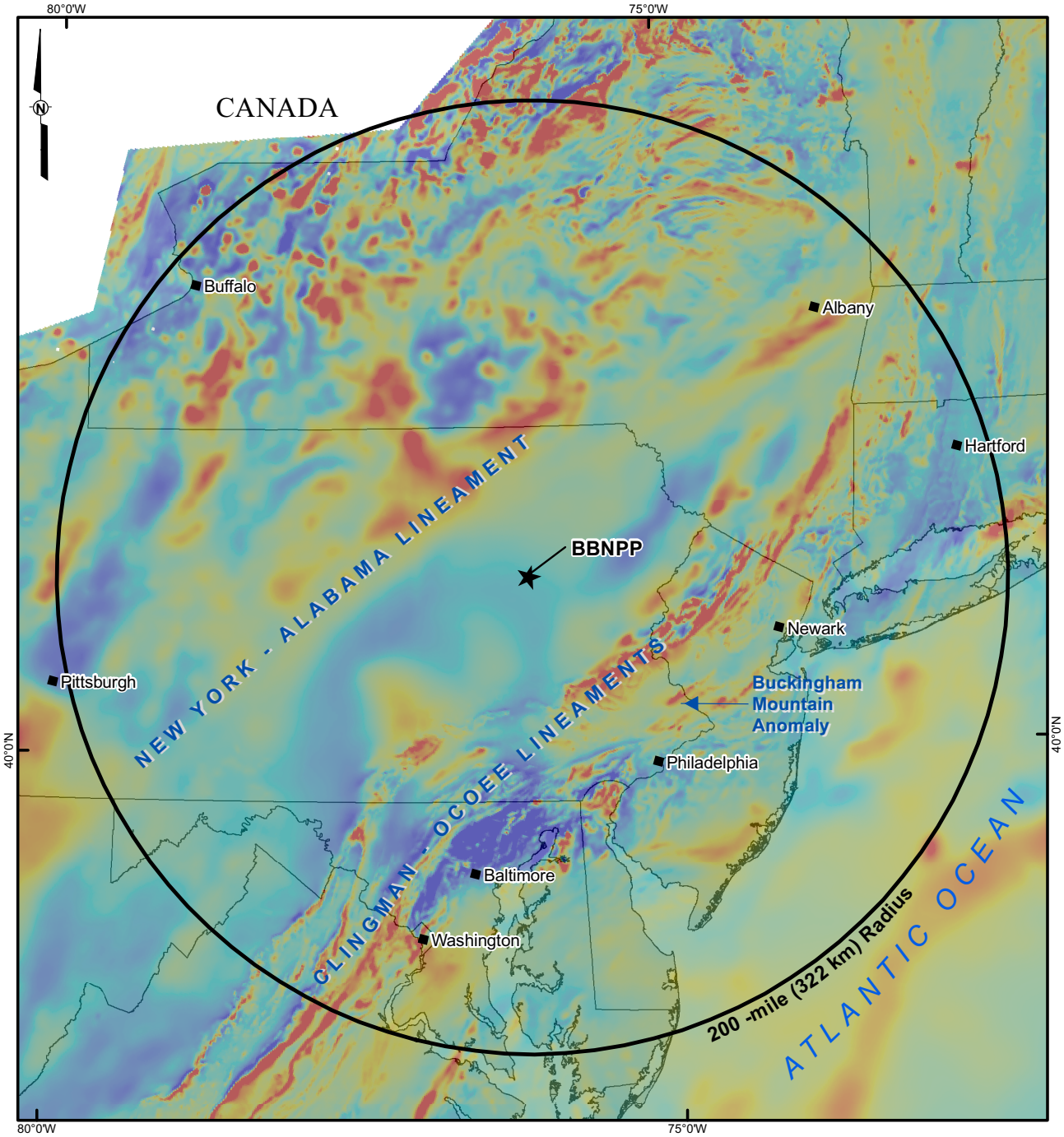
Figure 2.5-27 {Regional Magnetic Anomaly Map}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 200-mile (322 km) Radius

Aeromagnetics

8215 nanoteslas

0

-1730 nanoteslas

0 25 50 100 miles

0 25 50 100 kilometers

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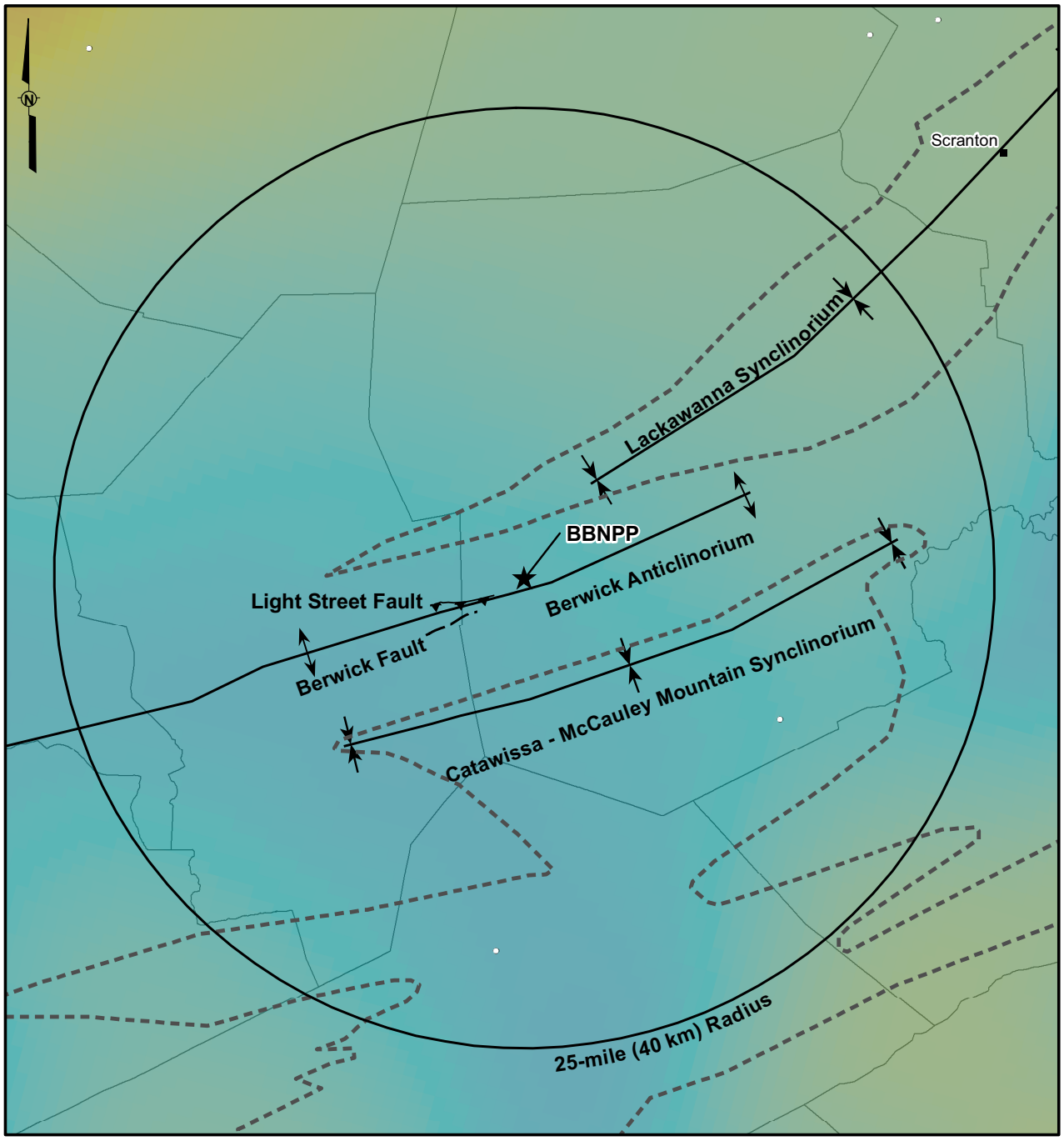
Figure 2.5-28 {Site Vicinity Magnetic Anomaly Map}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 25-mile (40 km) Radius

— — Anthracite Region

Earthquakes by Magnitude, m_b

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

Aeromagnetics

8215 nanoteslas

0

-1730 nanoteslas

0 2.5 5 10 miles

0 2.5 5 10 kilometers

REFERENCE:
- Bankey, 2002.
- Harrison, 2004.
- USGS, 2007.

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Figure 2.5-29 {Site Specific Stratigraphic Column}

Era	Period	Epoch	Age (Ma)	Unit	Thickness (ft)
Cenozoic	Quaternary	Holocene	0.01	**Stratified Drift**	38.5
		Pleistocene	1.8		
Paleozoic	Devonian	Upper	360	**Harrell Formation**	150
		Middle	370	Hamilton Group: **Mahantango Formation**	1,500
				Hamilton Group: **Marcellus Formation**	350
				Onondaga Formation	175
		Lower	391	**Old Port Formation**	100-150
	Silurian	Upper	417	**Keyser Formation**	125
				Tonoloway Formation	100
				Wills Creek Formation	750
		Lower	423	**Bloomsburg Formation**	464
				Mifflintown Formation	336
				Keefer Formation	670-1,070
				Rose Hill Formation	
				Tuscarora Formation	400-700
	Ordovician	Upper	443	**Juniata Formation**	600-1,125
				Bald Eagle Formation	700-1,313
				Reedsville Formation	600-1,800
		Middle	458	**Trenton Group** Antes Shale Coburn Limestone Salona Limestone	842
				Black River Group	632
				Loysburg Formation	263-475
		Lower	470	**Beekmantown Group** Bellefonte Dolomite Axemann Limestone Nittany Dolomite Stonehenge Formation	3,159-4,200
	Cambrian	Upper	490	**Gatesburg Formation**	1,211
		Middle	510	**Warrior Formation**	400-1,340
				Pleasant Hill Formation	NOT REPORTED
		Lower	520	**Waynesboro Formation**	1,000+
Neo-Proterozoic	Ediacaran		543	Metamorphic/Igneous	

REFERENCES:
- Crangle, 2002
- Gold, 2003
- Inners, 1978
- Kauffman, 1999
- Laughrey, 1999
- McElroy, 2007
- Thompson, 1999

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Figure 2.5-30 {Ten-Foot Solid Core of Mahantango Shale with No Open Fractures}

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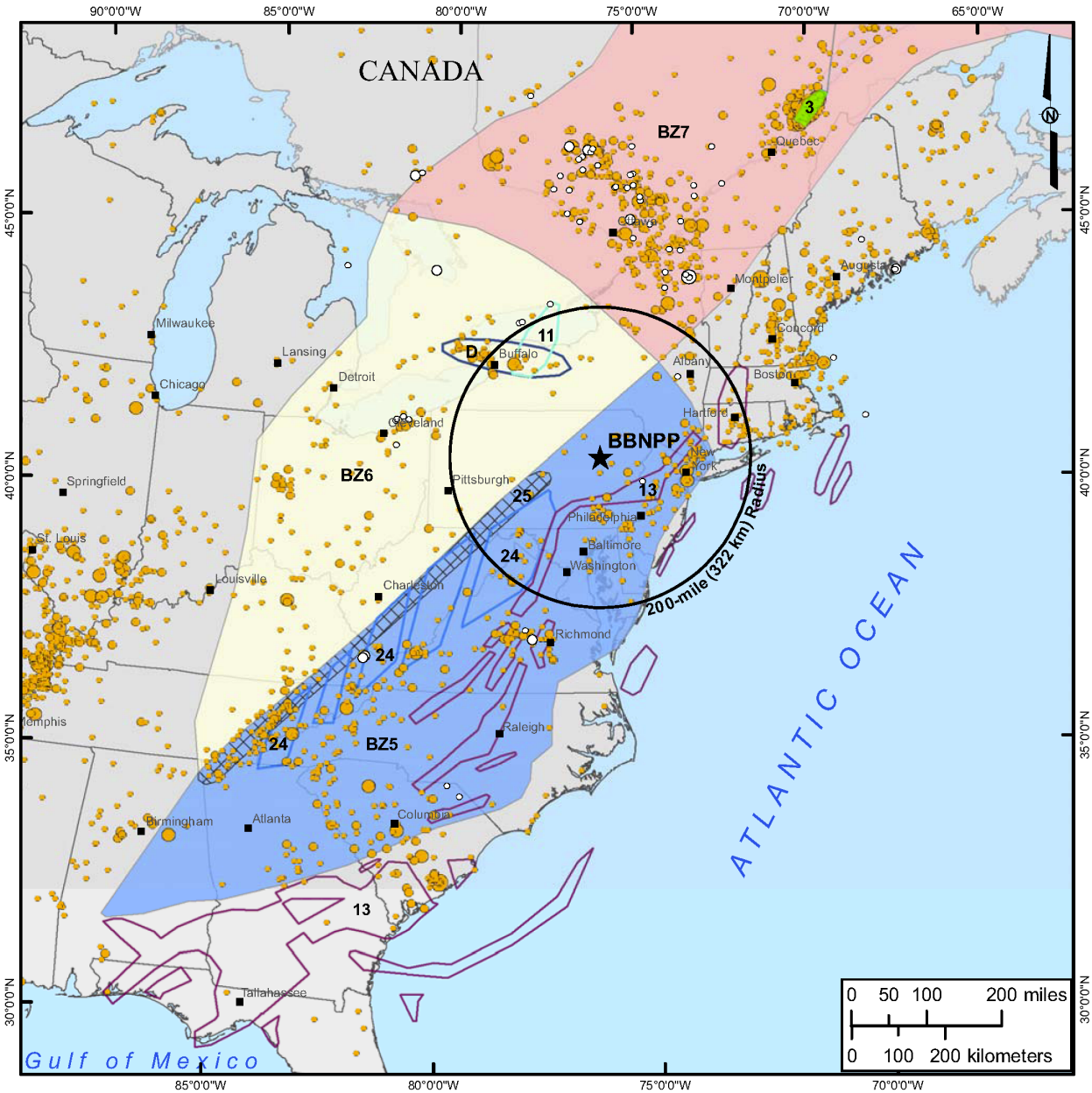
Figure 2.5-31 {Bechtel Group EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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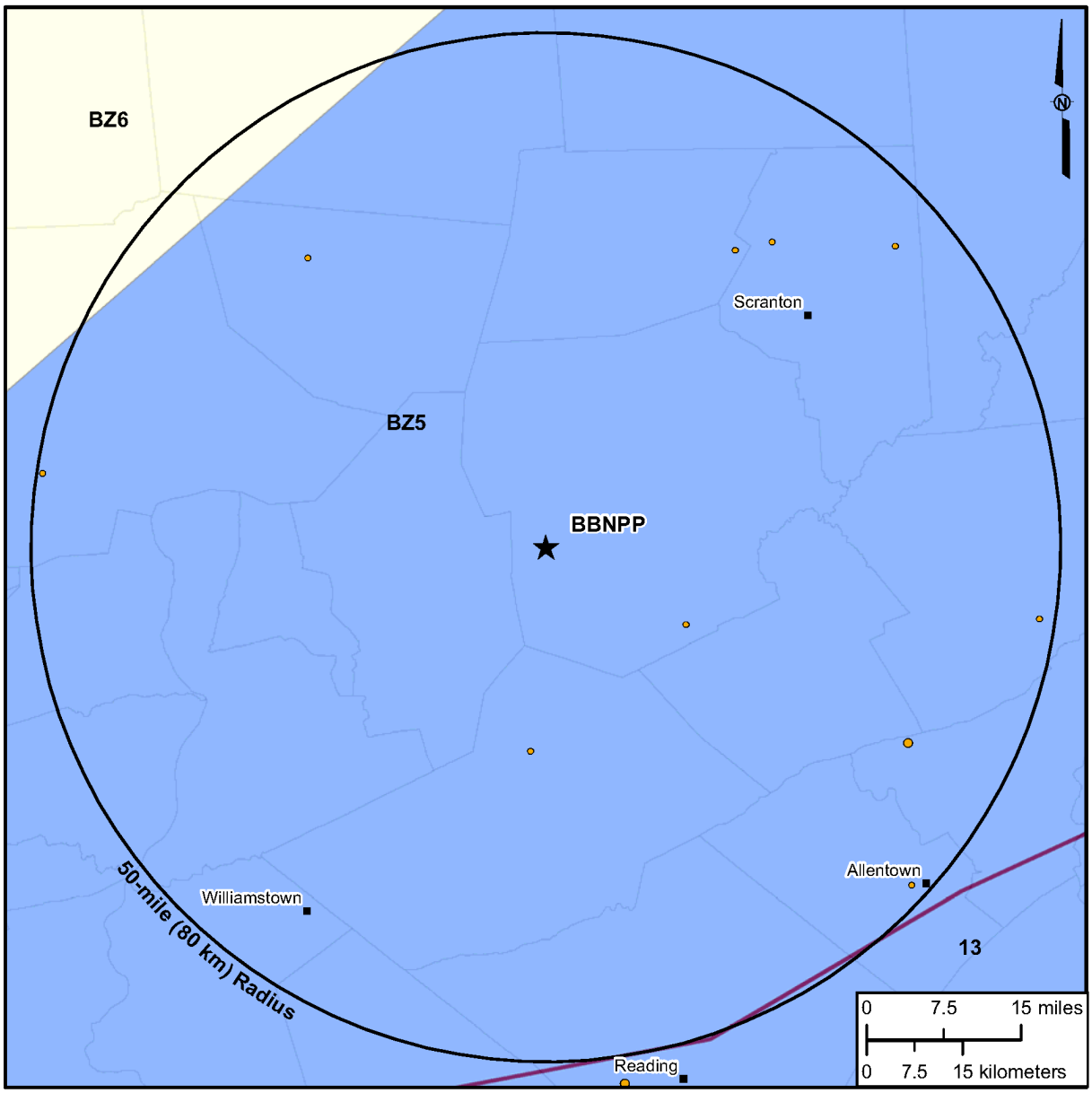
Figure 2.5-32 {Bechtel Group EPRI Source Zones 50-mile Radius}



LEGEND

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 26 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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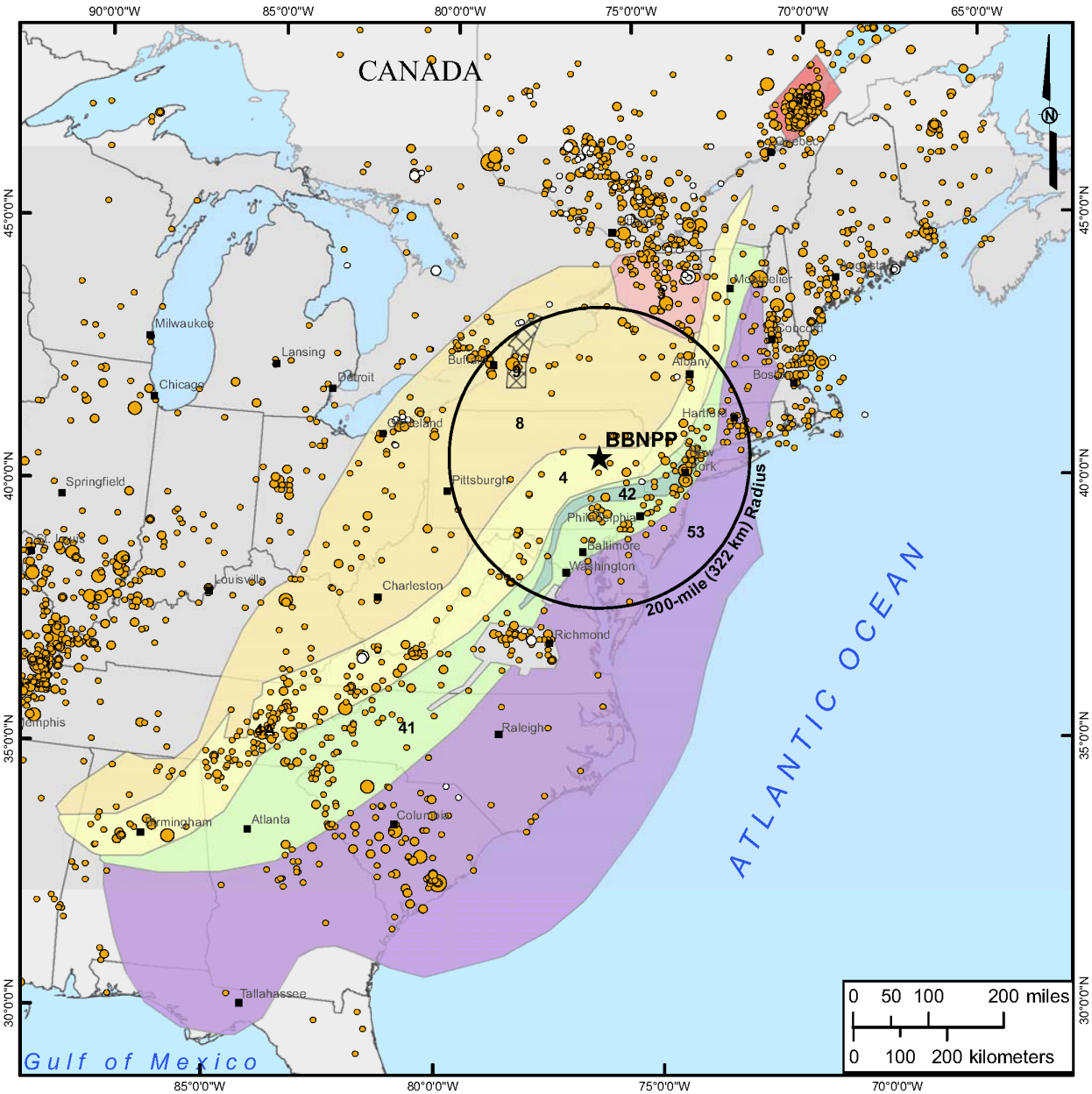
Figure 2.5-33 {Dames & Moore EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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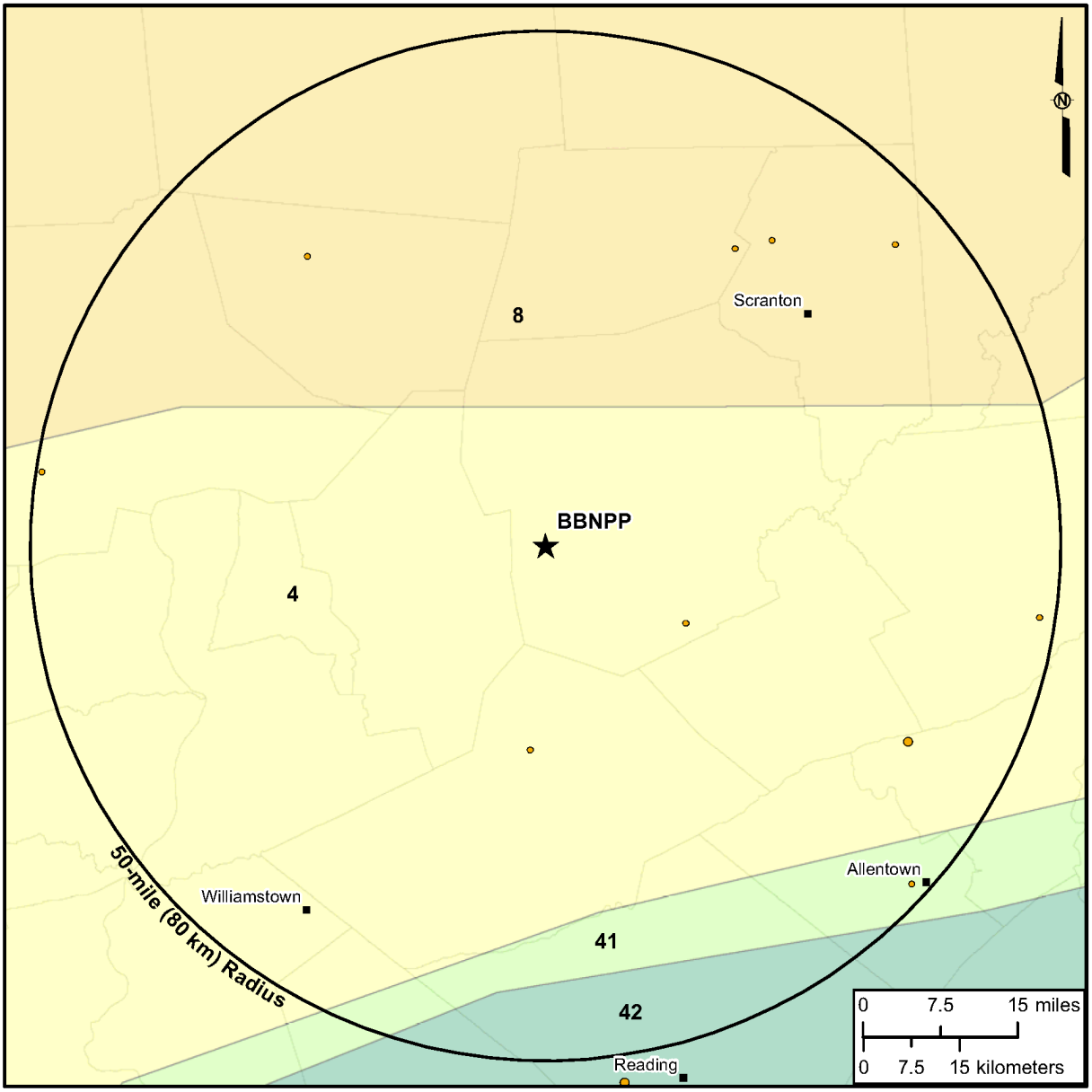
Figure 2.5-34 {Dames & Moore EPRI Source Zones 50-mile Radius}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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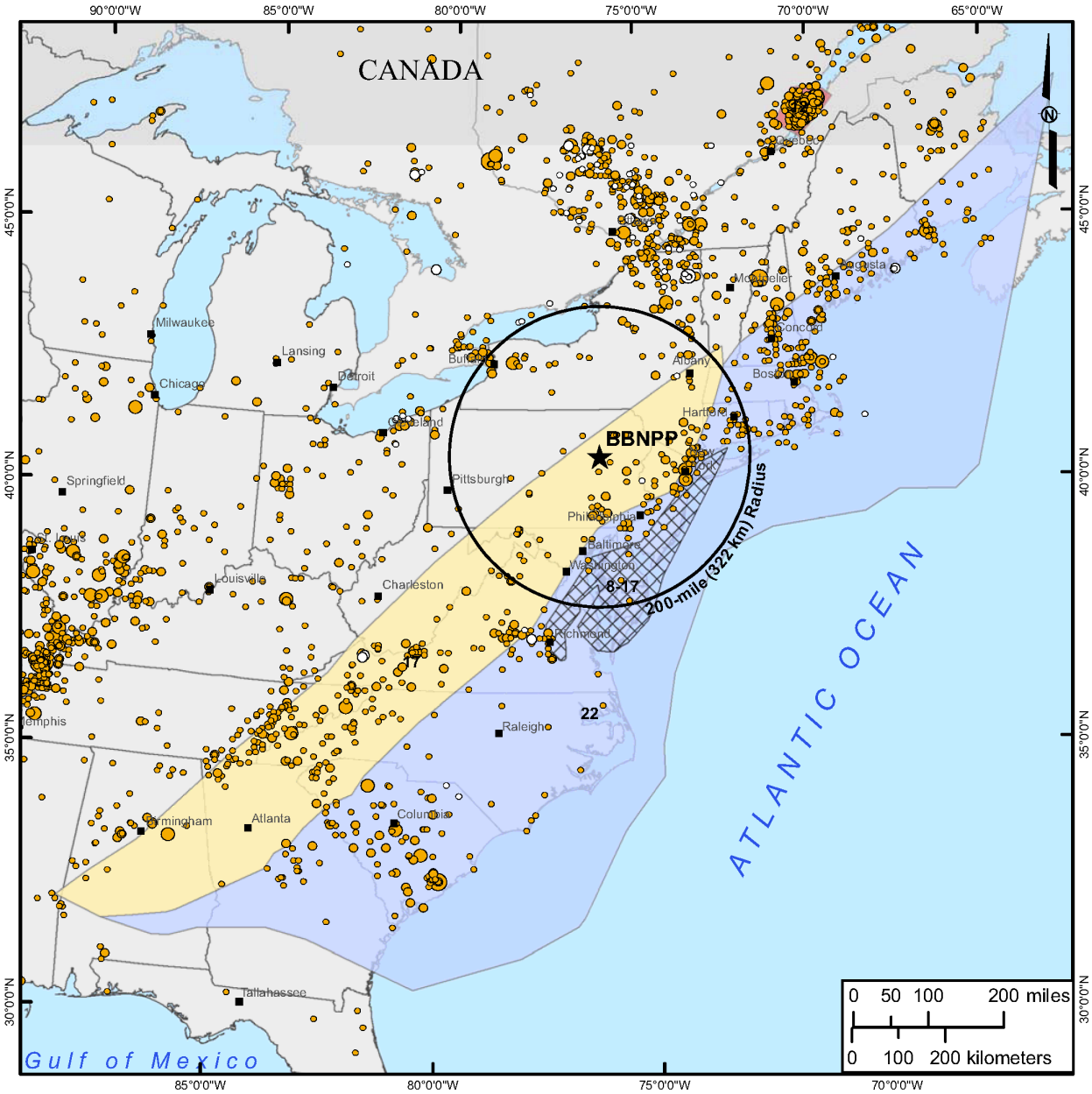
Figure 2.5-35 {Law Engineering EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

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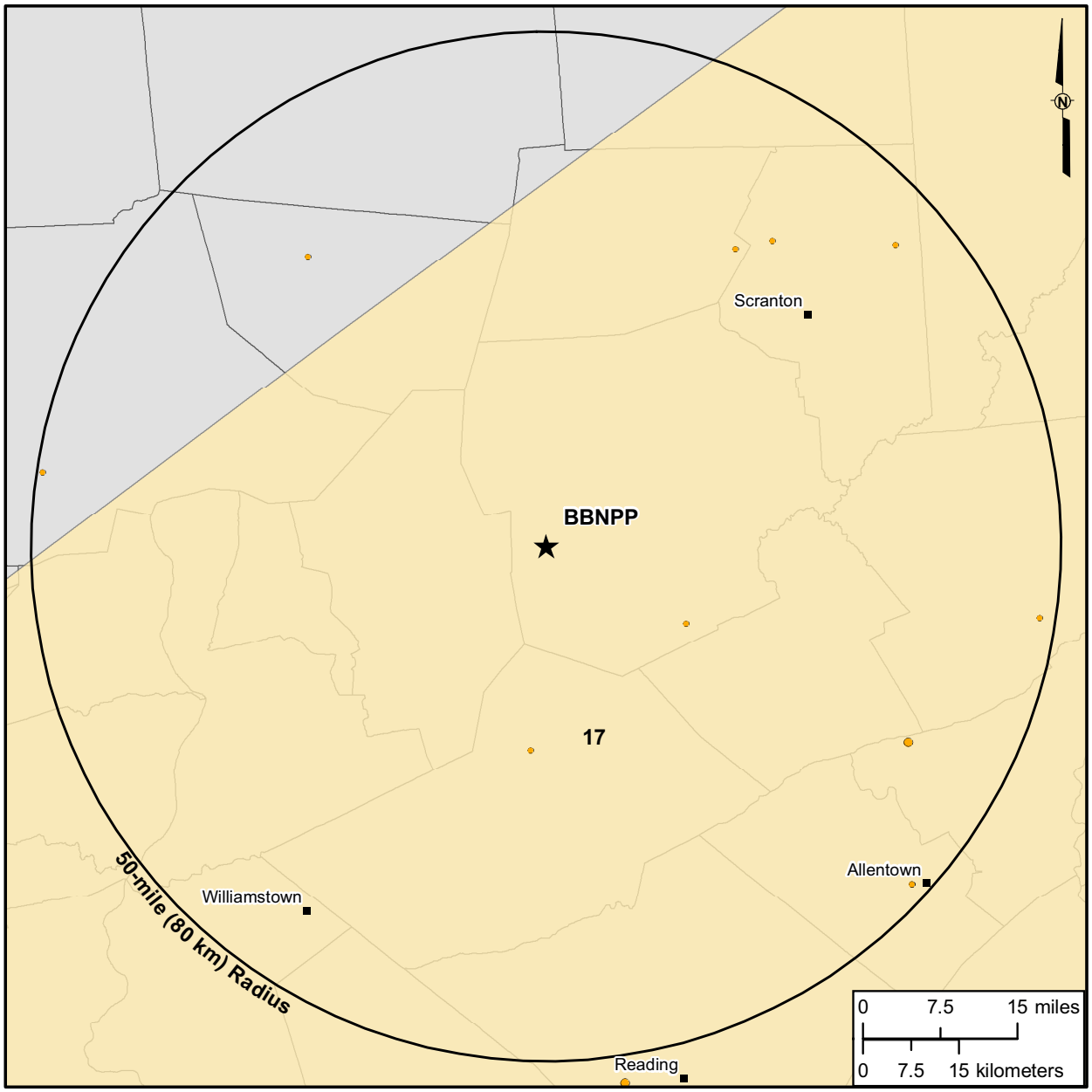
Figure 2.5-36 {Law Engineering EPRI Source Zones 50-mile Radius}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

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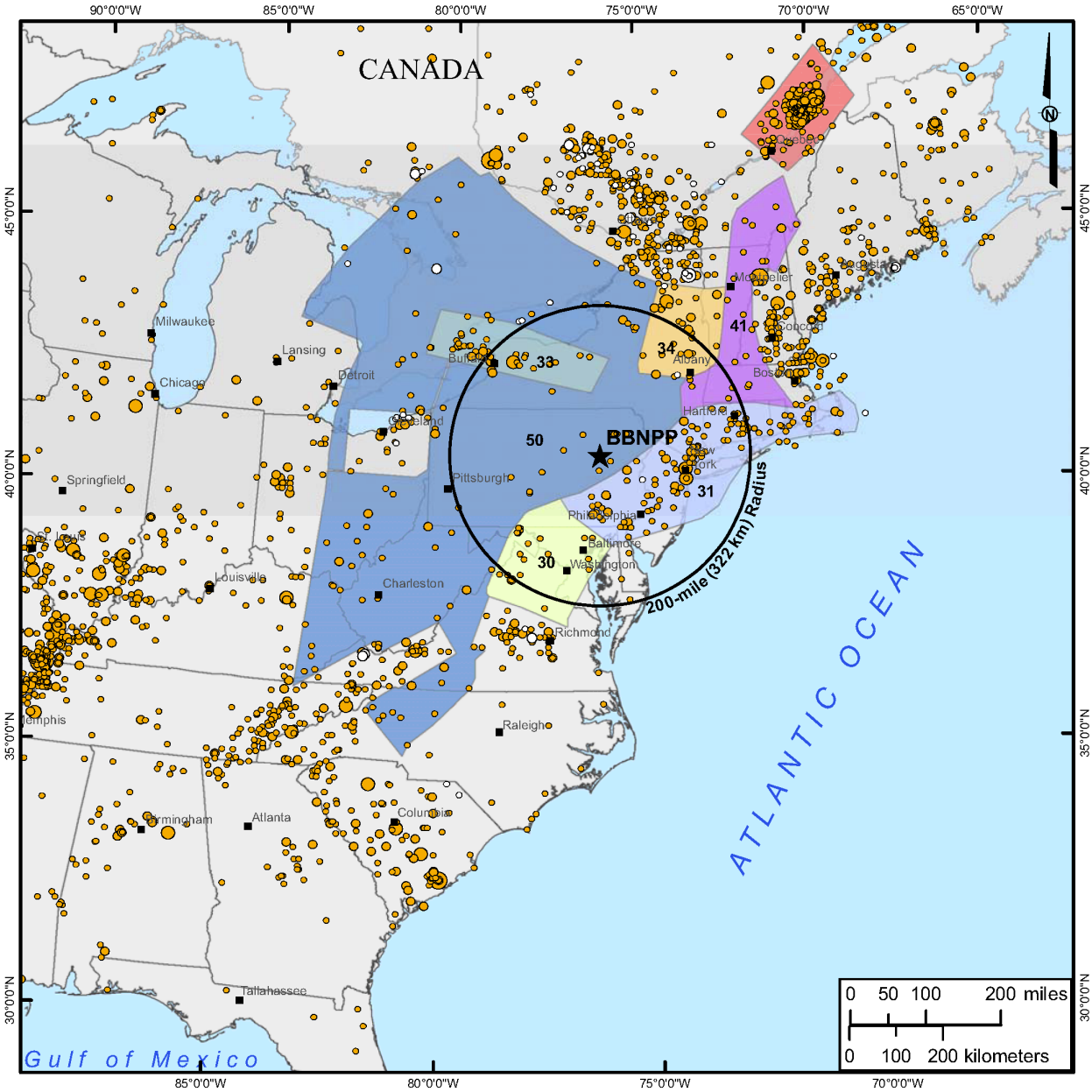
Figure 2.5-37 {Rondout Associates EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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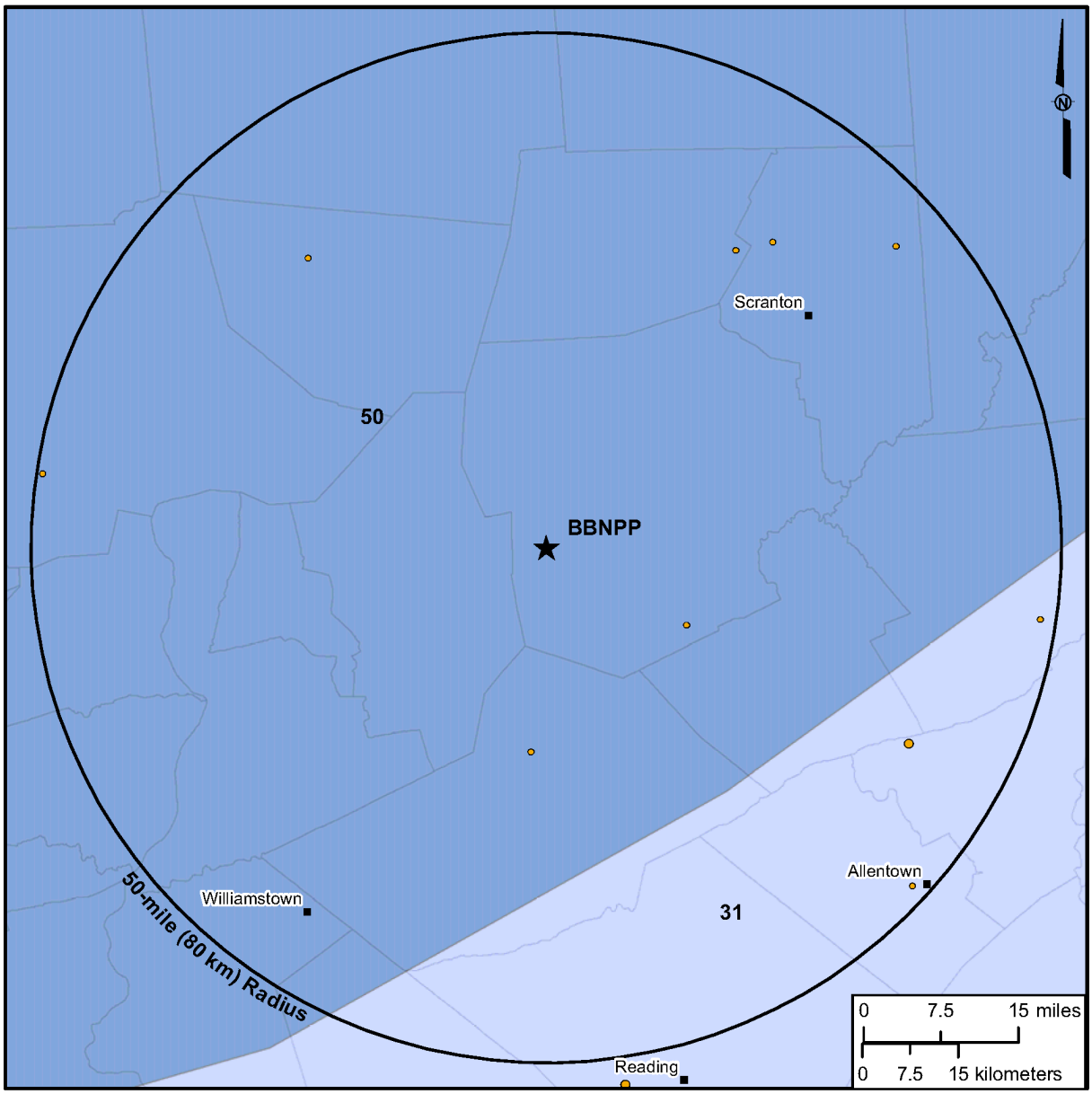
Figure 2.5-38 {Rondout Associates EPRI Source Zones 50-mile Radius}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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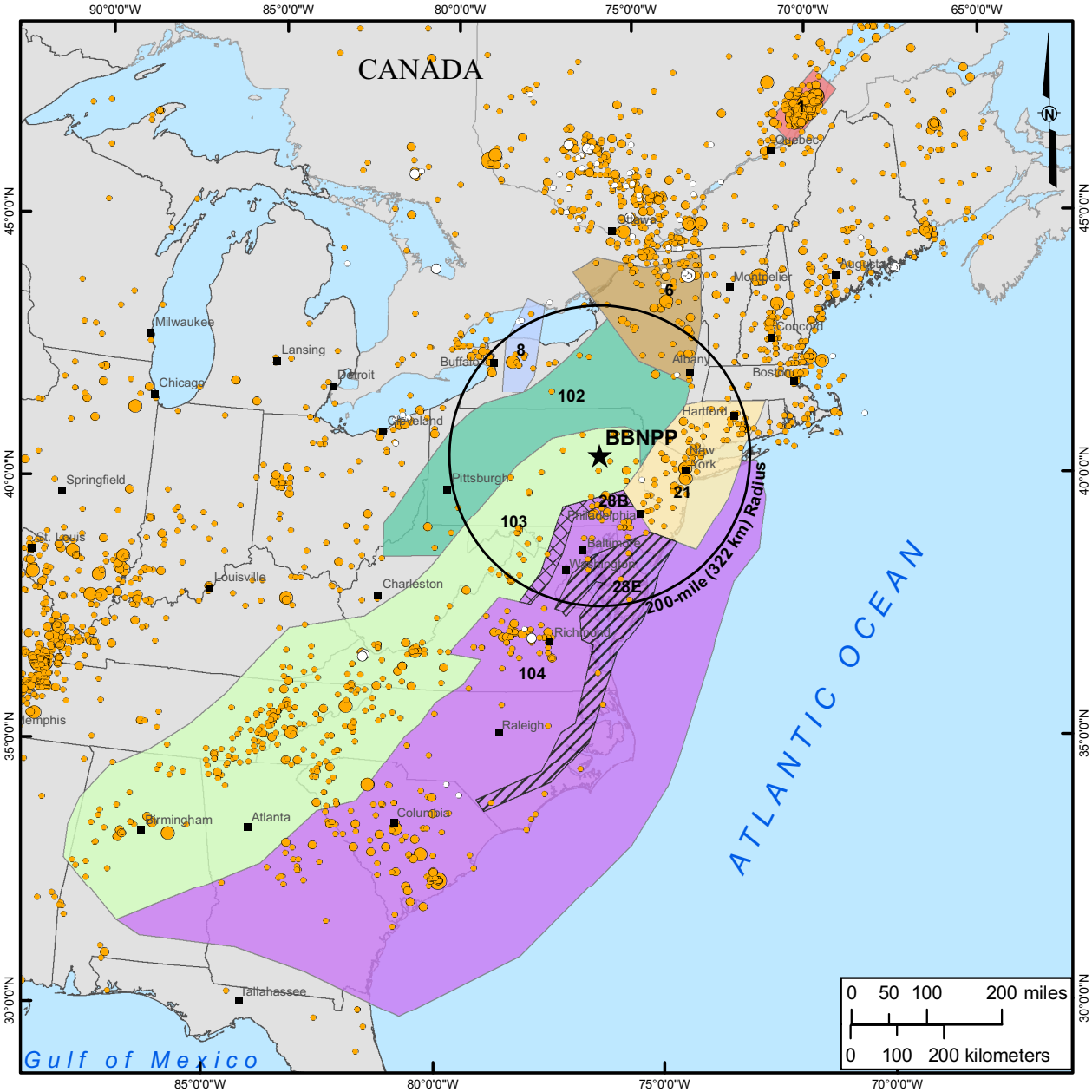
Figure 2.5-39 {Weston Geophysical EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 28B Zone of Mesozoic Basin
- 28E Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

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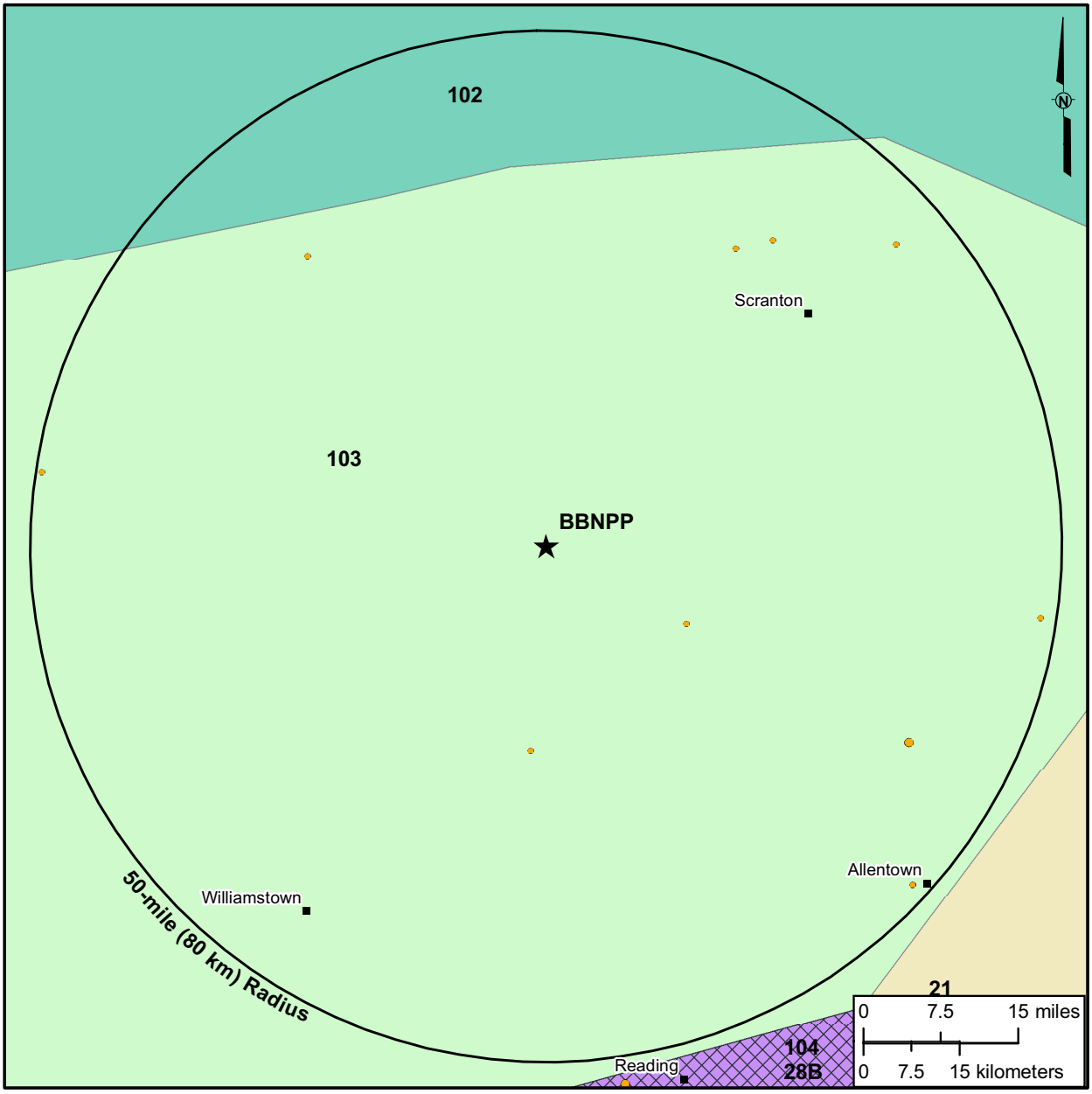
Figure 2.5-40 {Weston Geophysical EPRI Source Zones 50-mile Radius}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 28B Zone of Mesozoic Basin
- 28E Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

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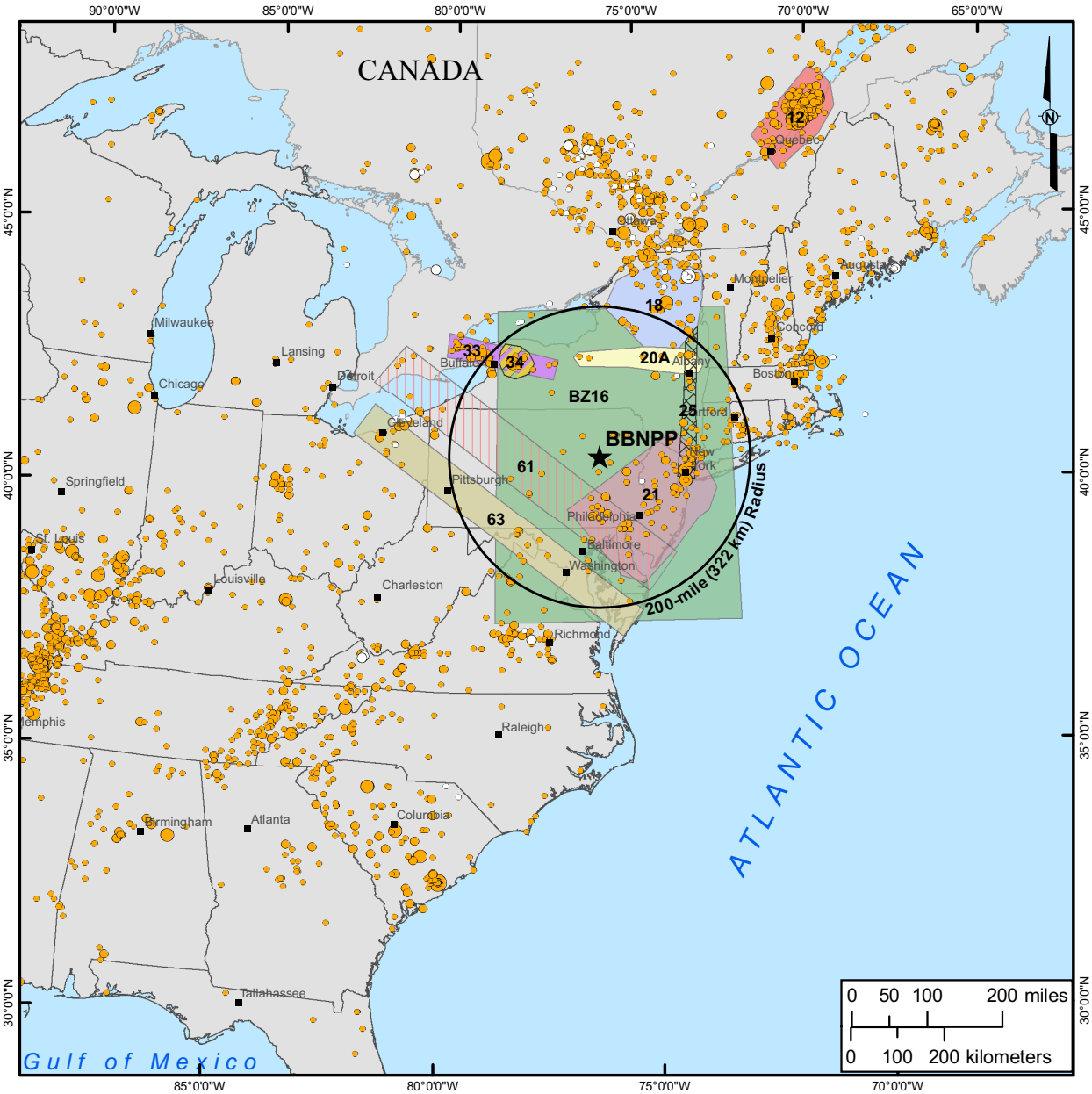
Figure 2.5-41 {Woodward-Consultants EPRI Source Zones}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 25 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 63 Pittsburgh - Washington Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 61 Tyrone - Mt. Union Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

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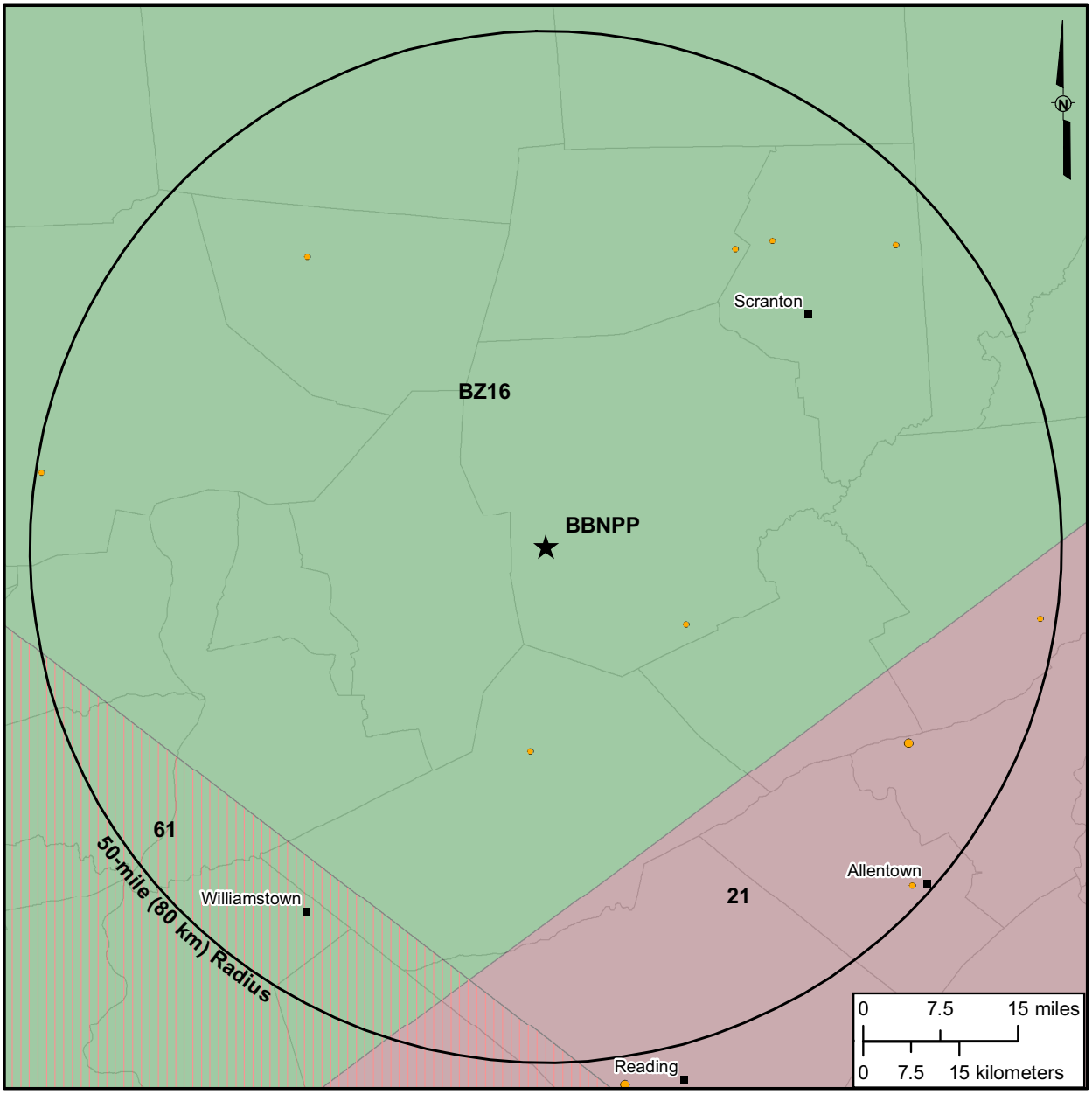
Figure 2.5-42 {Woodward-Clyde Consultants EPRI Source Zones 50-mile Radius}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 50-mile (80 km) Radius

Earthquakes by Magnitude, m_b

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 25 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 63 Pittsburgh - Washington Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 61 Tyrone - Mt. Union Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

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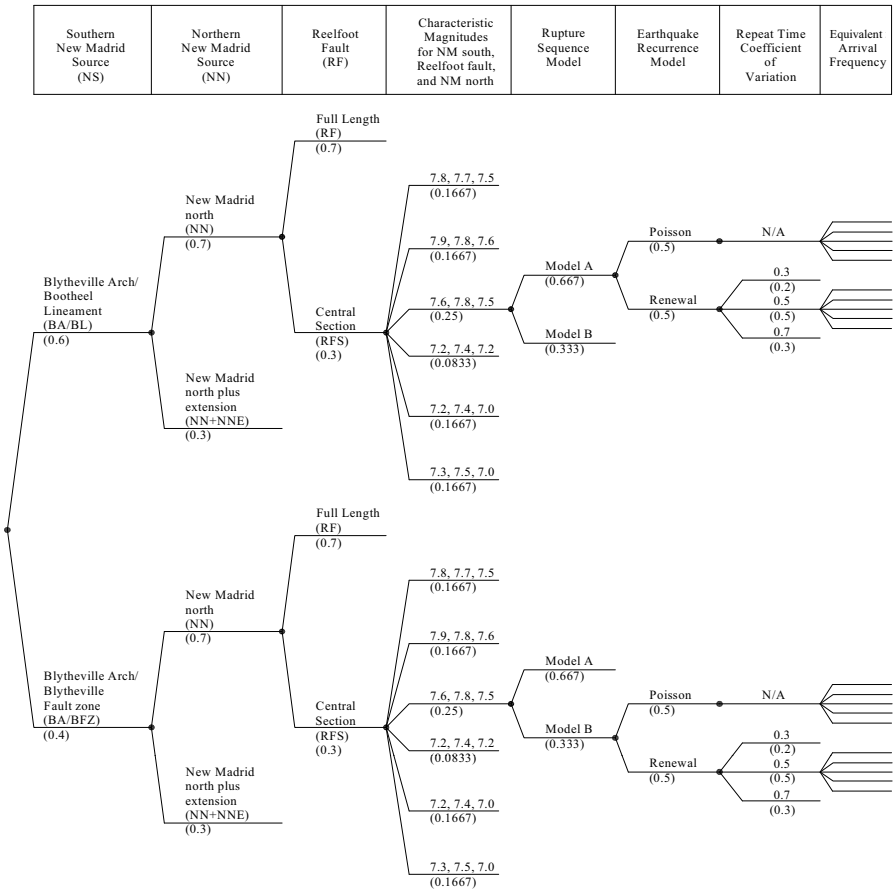
Figure 2.5-43 {Logic Tree of New Madrid Fault System}



Adapted from the Seismic Hazards Report for the Clinton ESP Site .
See Figure 4.1-1 of Appendix B (EGC 2006)

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Figure 2.5-44 {Uniform Hazard Spectra for Hard Rock at 7 Structural Frequencies}

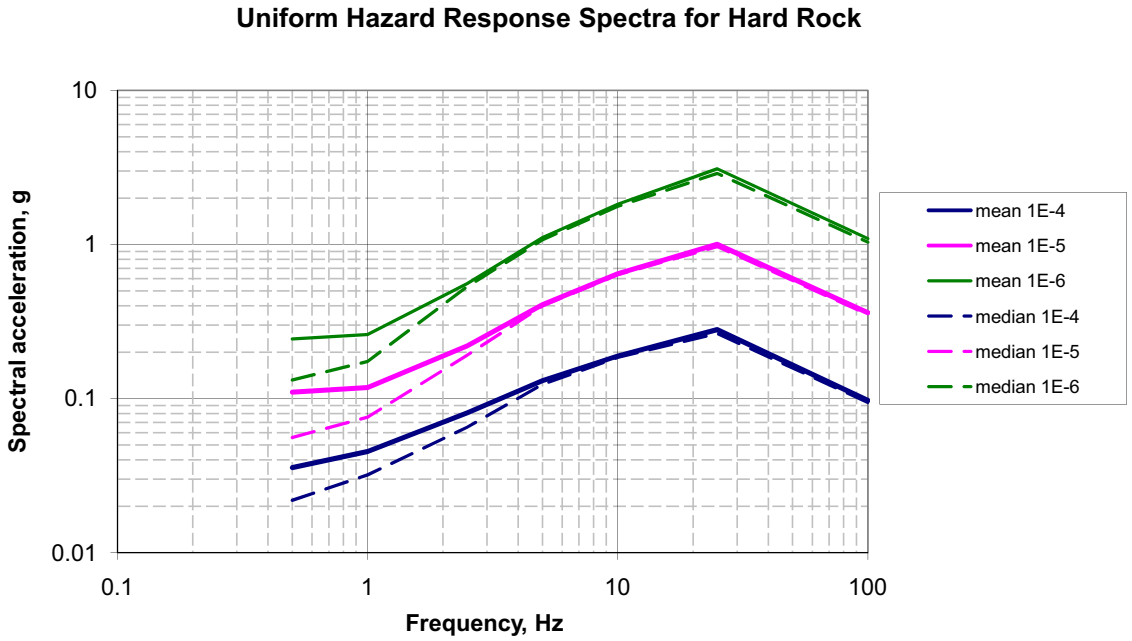

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Figure 2.5-45 {Mean 10-4 Rock Deaggregation for 1 and 2.5 Hz}

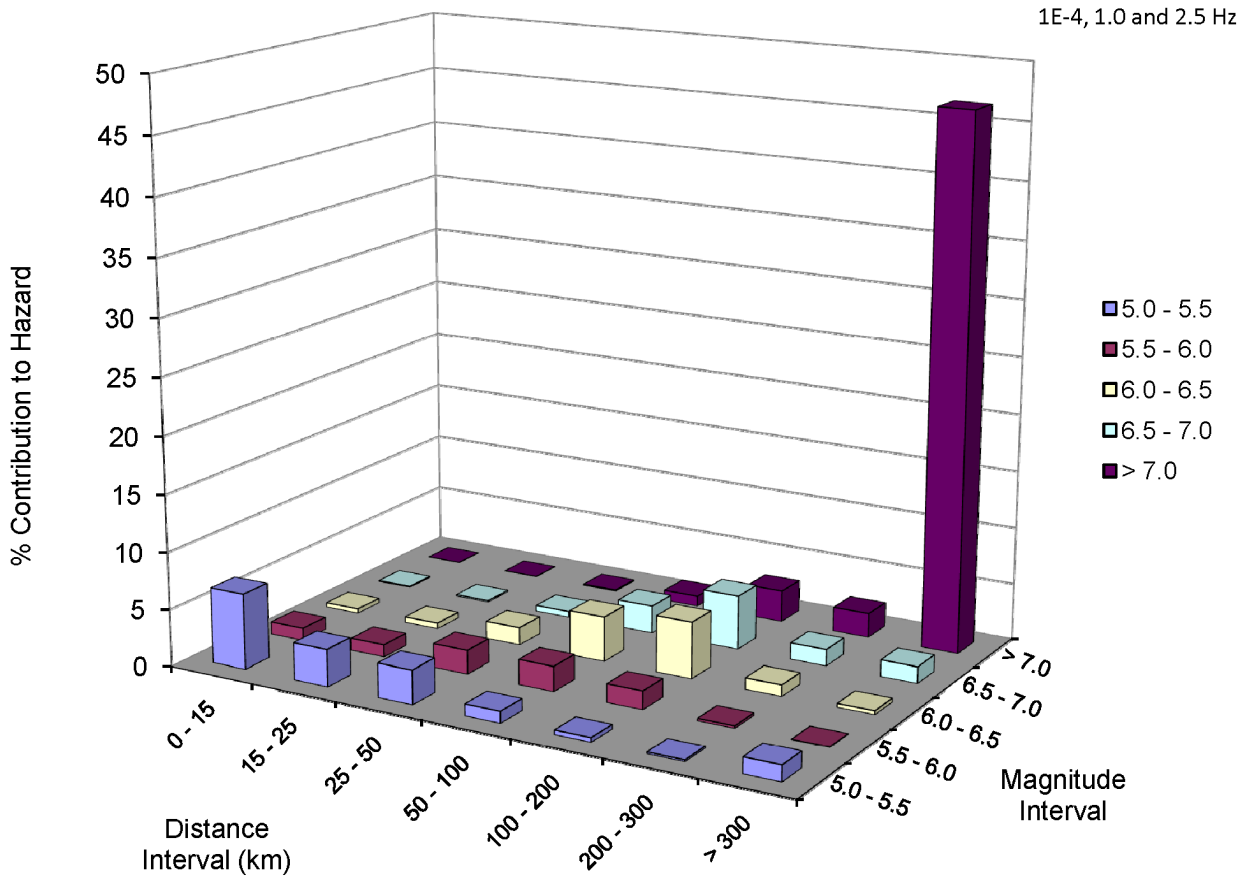

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Figure 2.5-46 {Mean 10-4 Rock Deaggregation for 5 and 10 Hz}

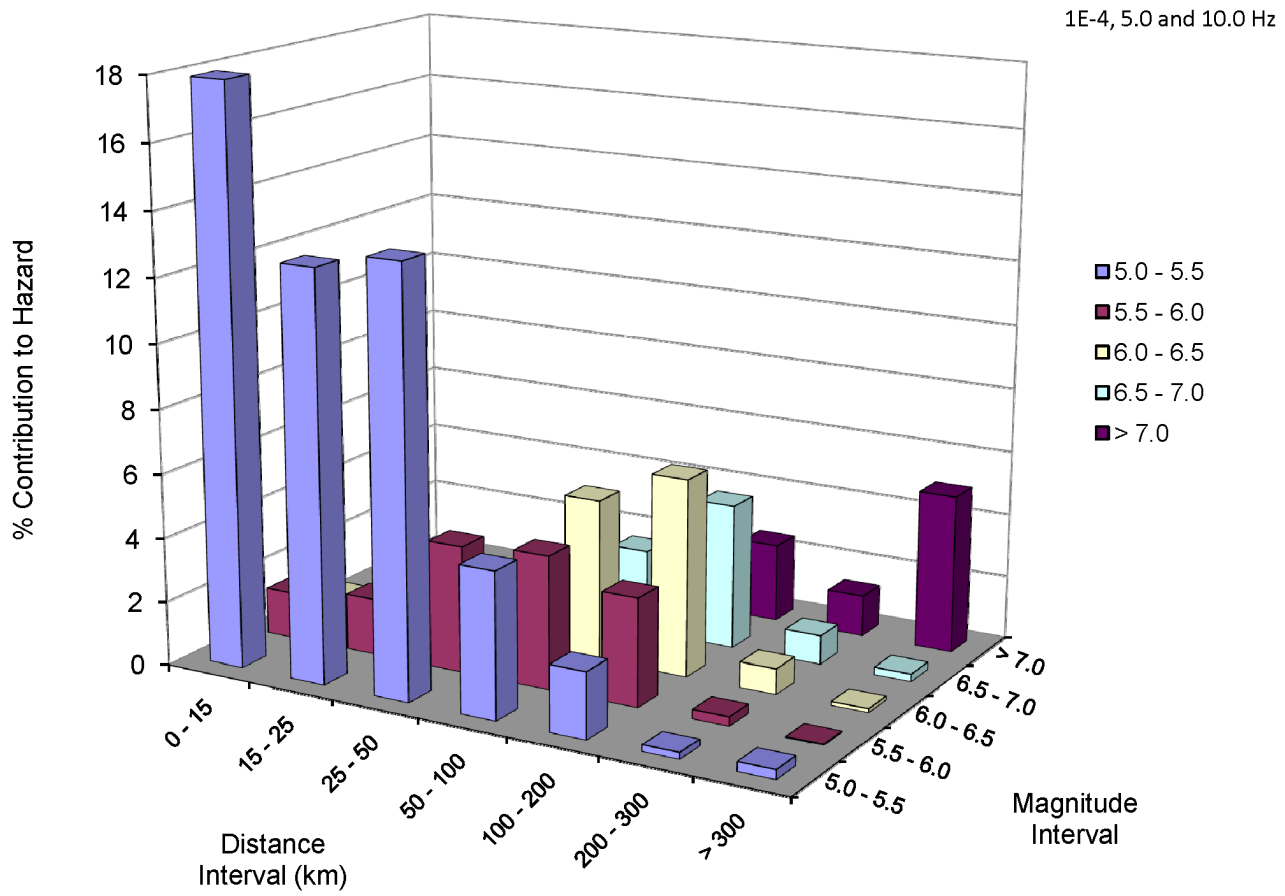

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Figure 2.5-47 {Mean 10-5 Rock Deaggregation for 1 and 2.5 Hz}

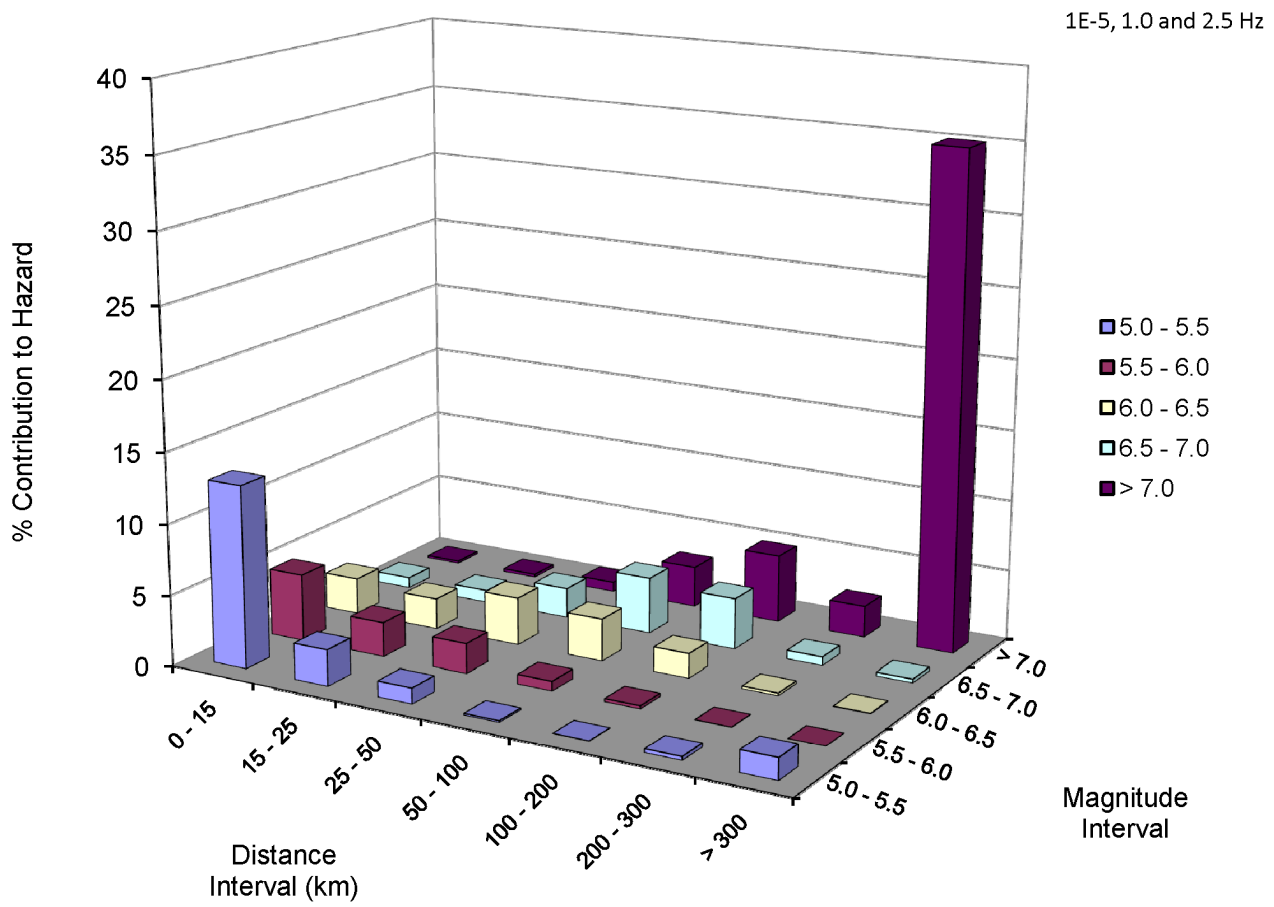

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Figure 2.5-48 {Mean 10-5 Rock Deaggregation for 5 and 10 Hz}

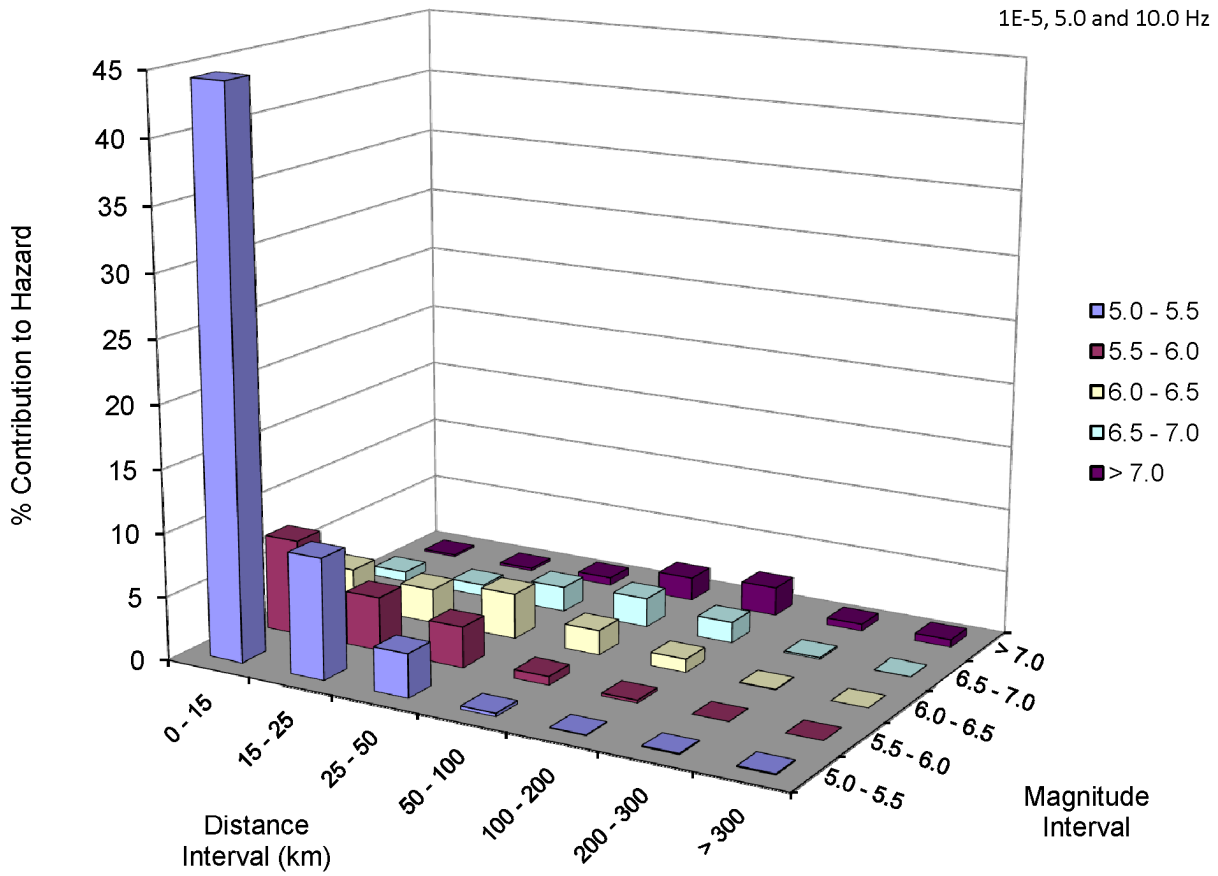

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Figure 2.5-49 {Smooth Hard Rock UHRS Spectra}

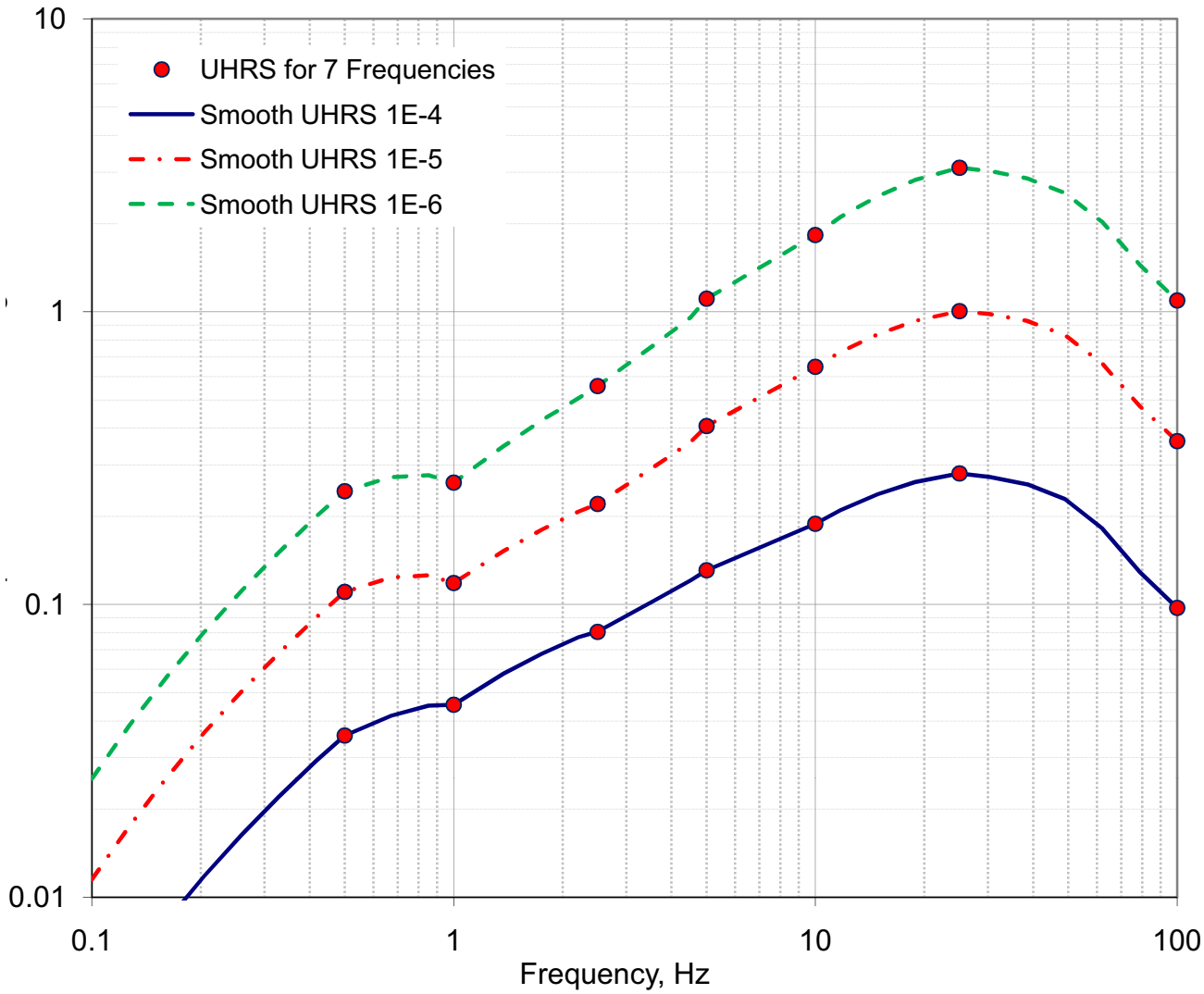

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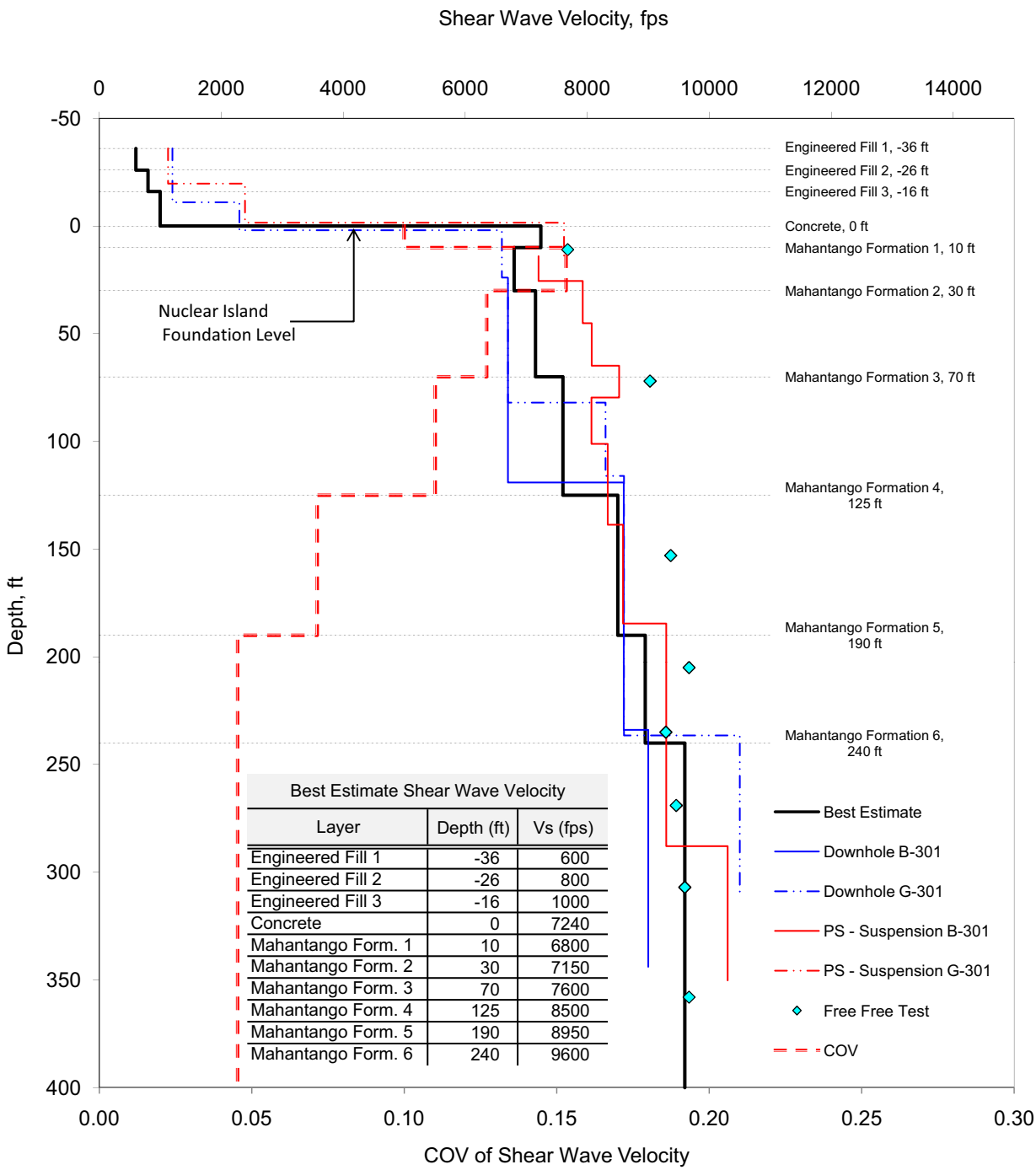
Figure 2.5-50 {Shear-Wave Velocity Vs and its Coefficient of Variation for Depth to 350 ft (107m)}



Best Estimate Shear Wave Velocity

Layer	Depth (ft)	Vs (fps)
Engineered Fill 1	-36	600
Engineered Fill 2	-26	800
Engineered Fill 3	-16	1000
Concrete	0	7240
Mahantango Form. 1	10	6800
Mahantango Form. 2	30	7150
Mahantango Form. 3	70	7600
Mahantango Form. 4	125	8500
Mahantango Form. 5	190	8950
Mahantango Form. 6	240	9600

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Figure 2.5-51 {Best Estimate Shear-Wave Velocity Vs and its Coefficient of Variation for Depth to 190 ft (57.9 m)}

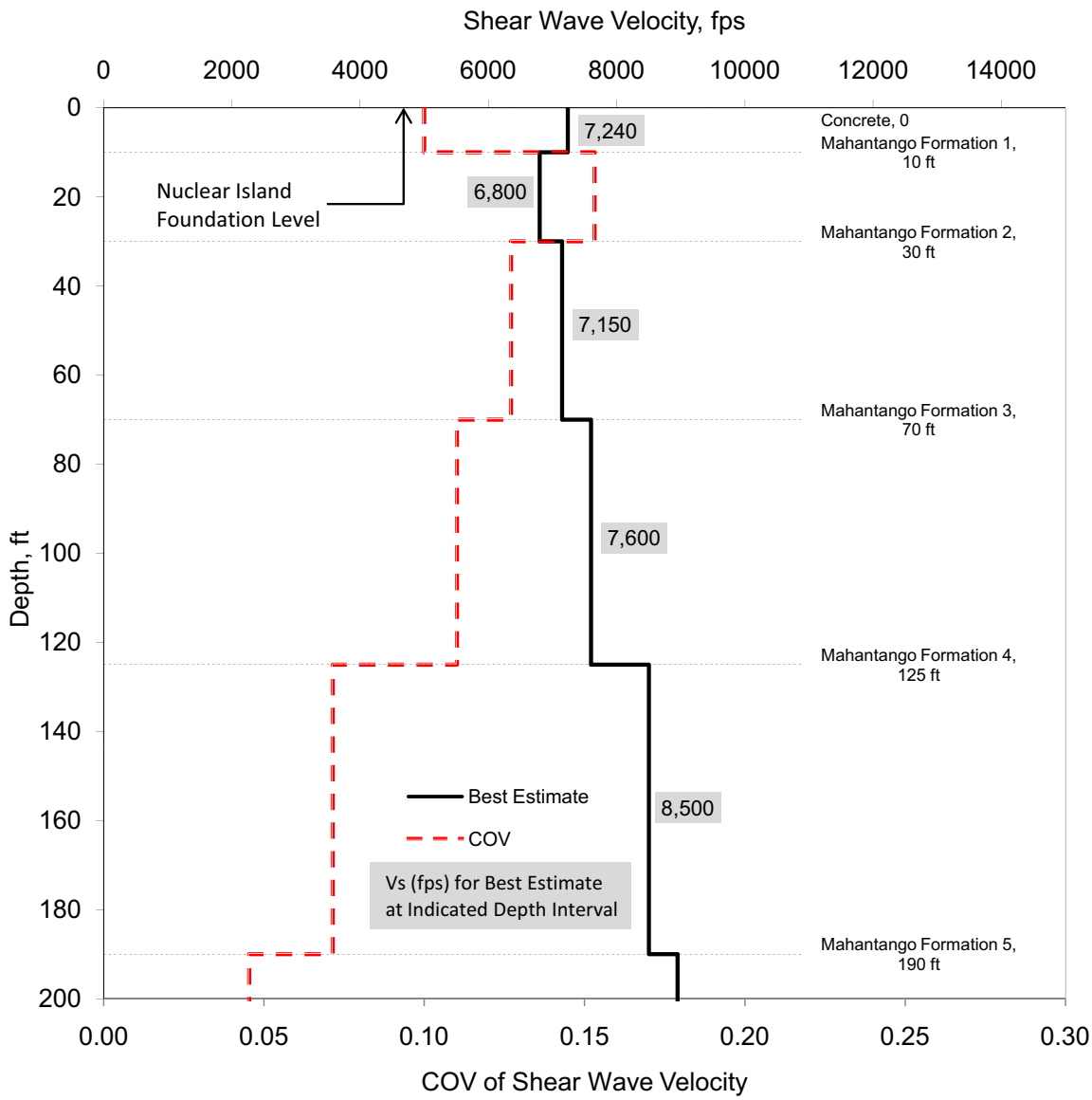

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Figure 2.5-52 {Shear-wave Velocity Vs. Depth for Profiles 1 through 60}

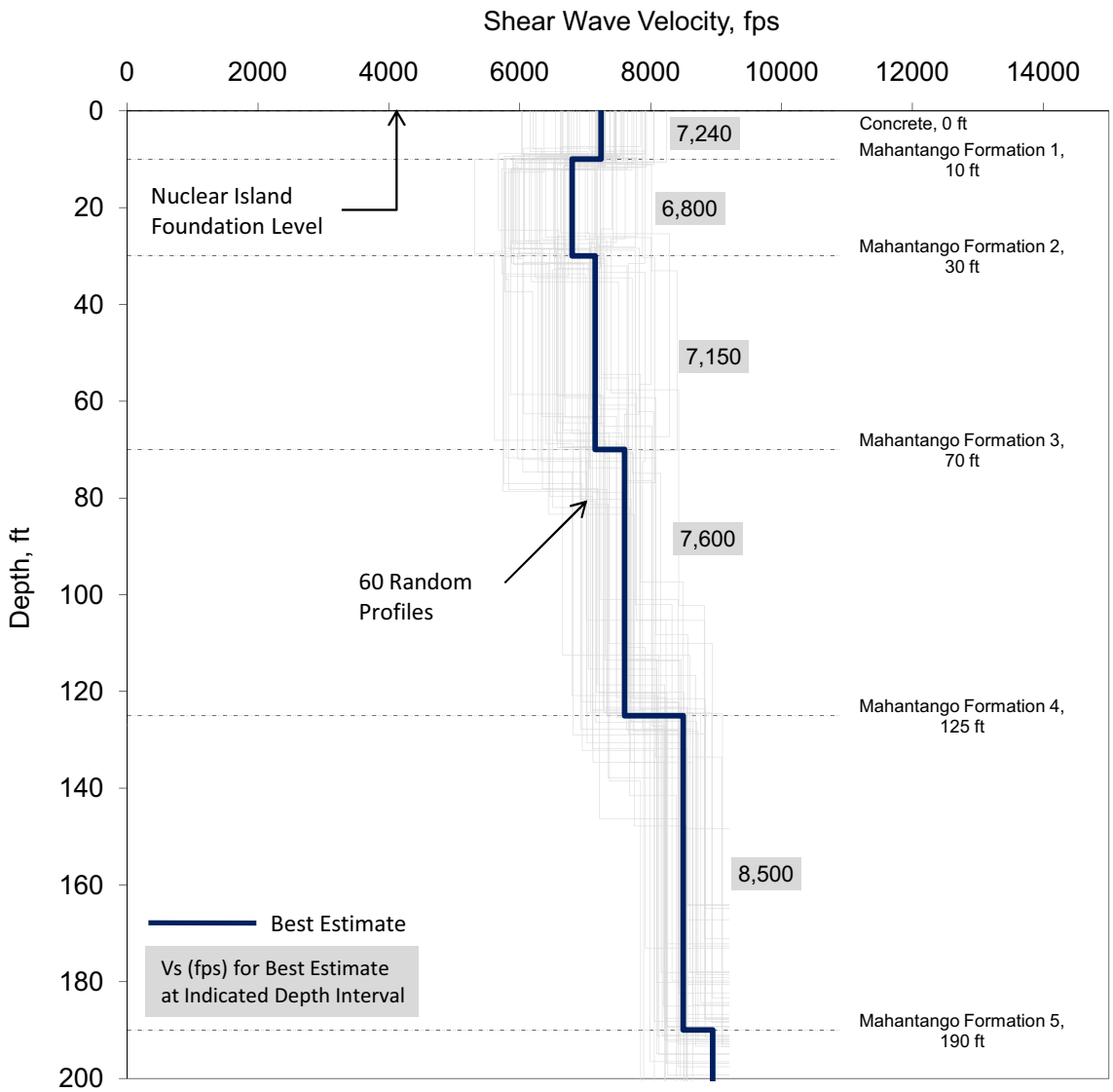

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Figure 2.5-53 {Mean + Standard Deviation of Shear-wave Velocity (Vs) Vs. Depth for all 60 profiles, Compared to Best Estimate Profile described in Section 2.5.2.5.1.2}

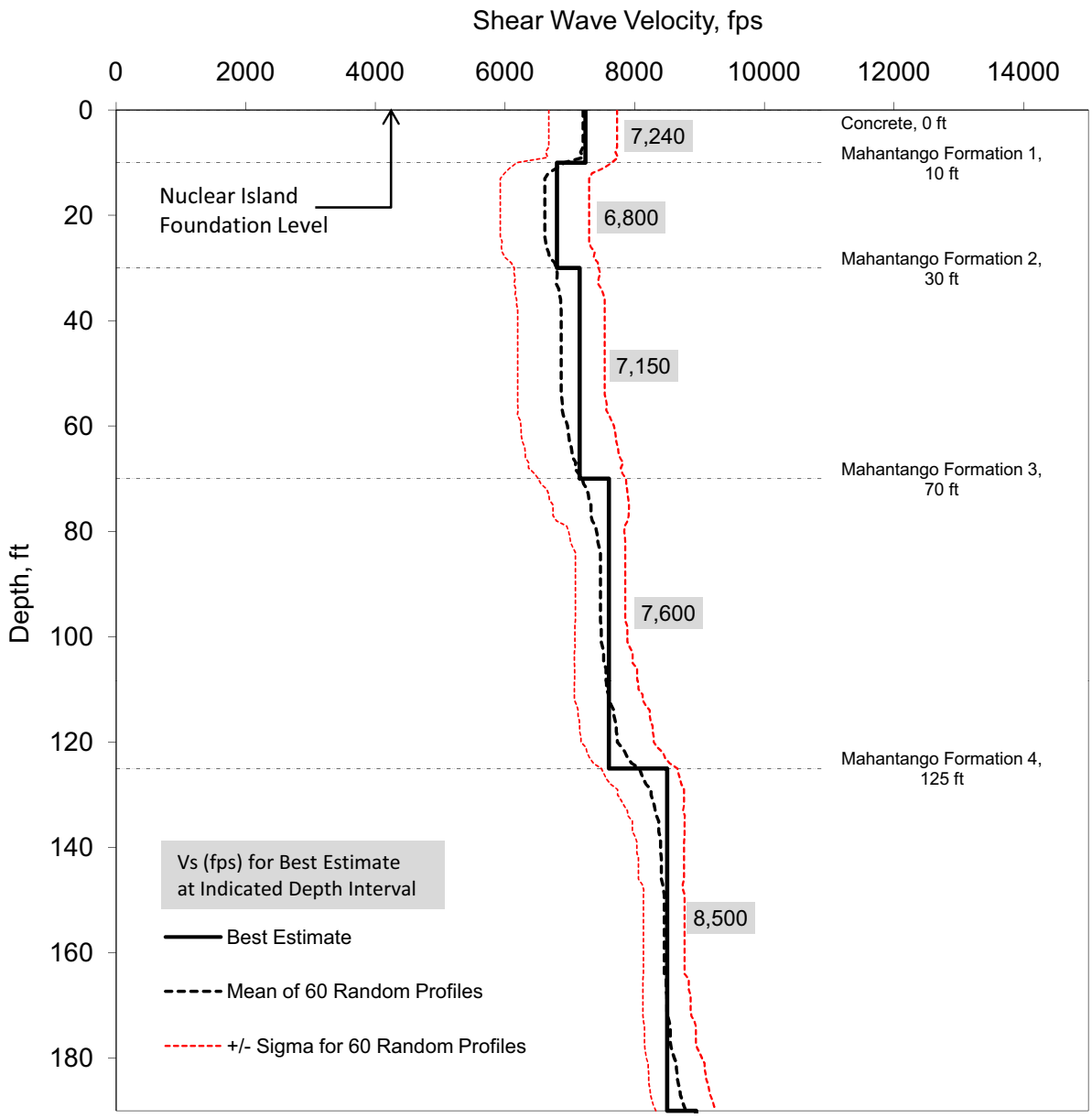

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Figure 2.5-54 {G/Gmax Curves Representing Uncertainty in Damping for Layer Backfill within Depth 0-20ft}

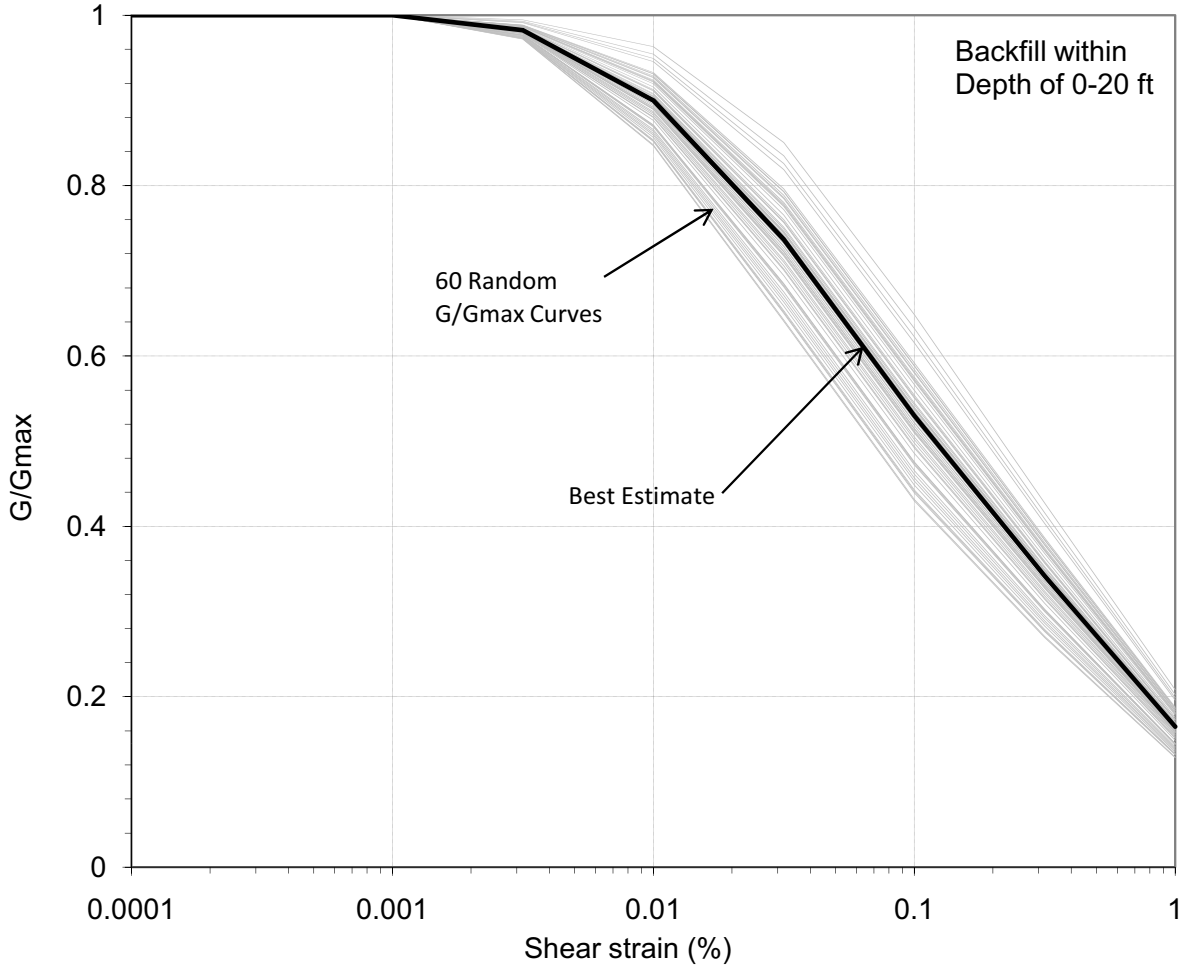

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Figure 2.5-55 {Damping Curves Representing Uncertainty in Damping for Layer Backfill within Depth 0-20 ft}

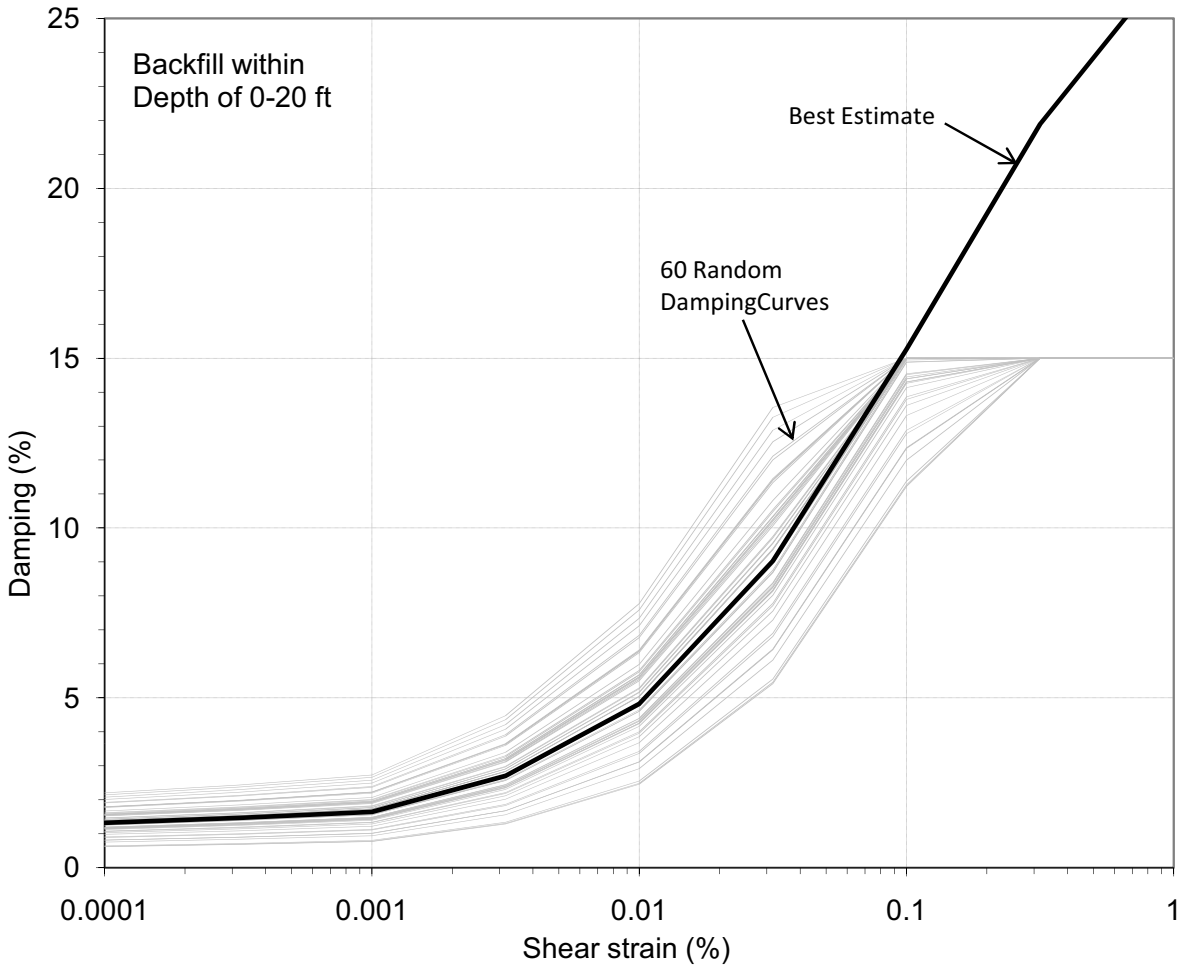

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Figure 2.5-56 {Mean Site Amplification Factor and Coefficient of Variation at the Top of Concrete for 10-4 HF DEM Input Motion}

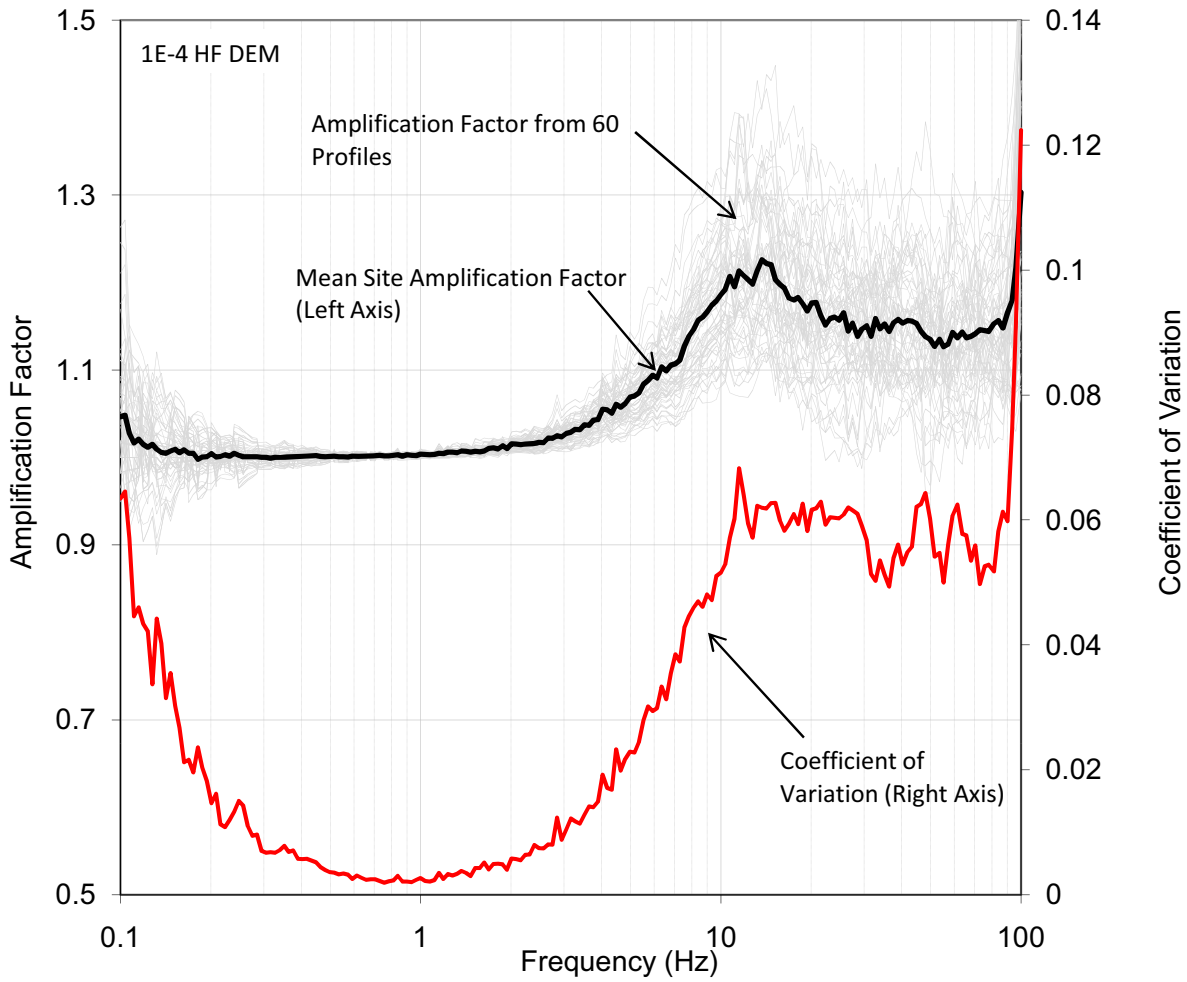

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Figure 2.5-57 {Maximum Strains Vs. Depth for 10-4 HF DEM Input Motion}

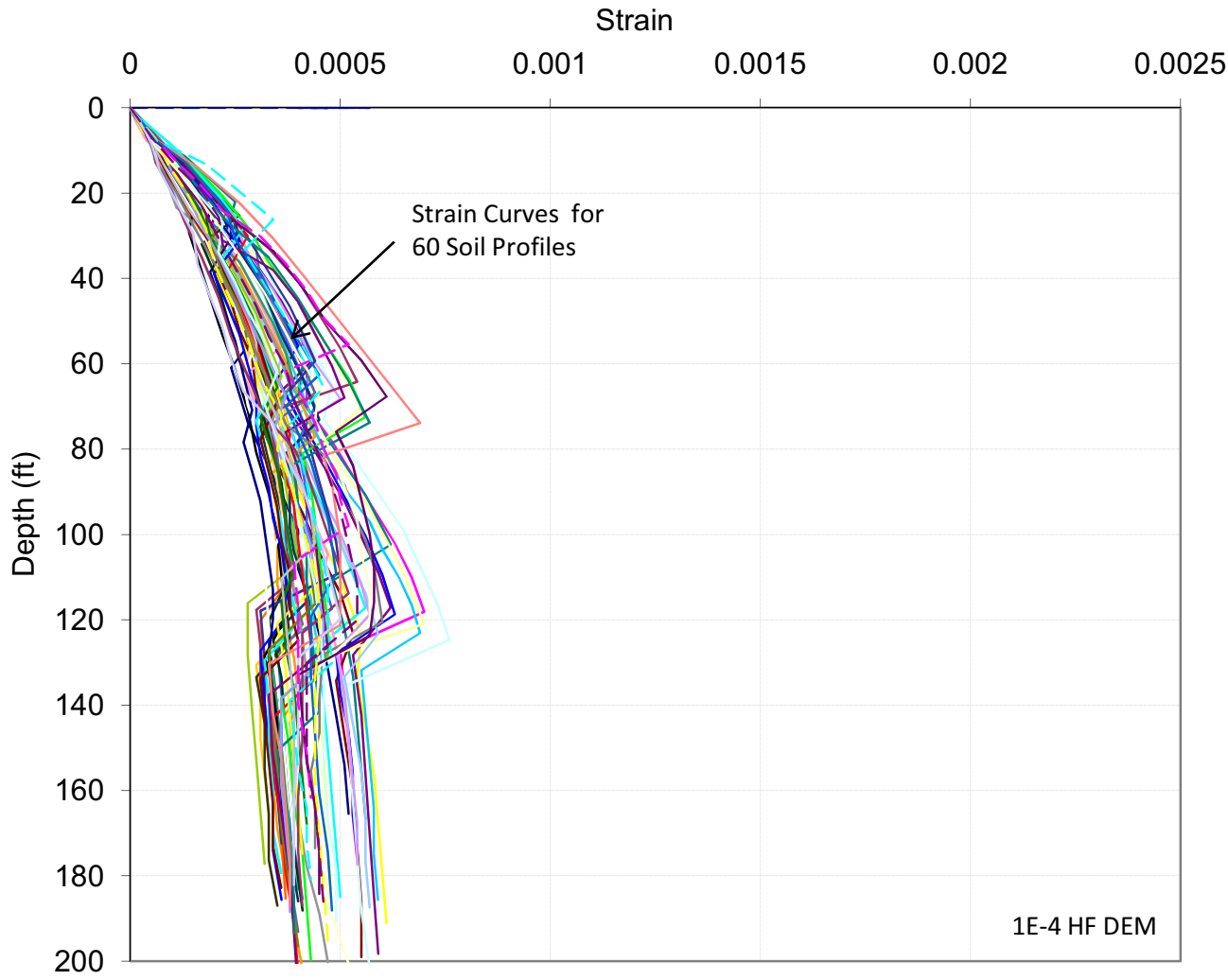

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Figure 2.5-58 {Mean Site Amplification Factor and Coefficient of Variation at the Top of Concrete for 10^{-4} LF DEM Input Motion}

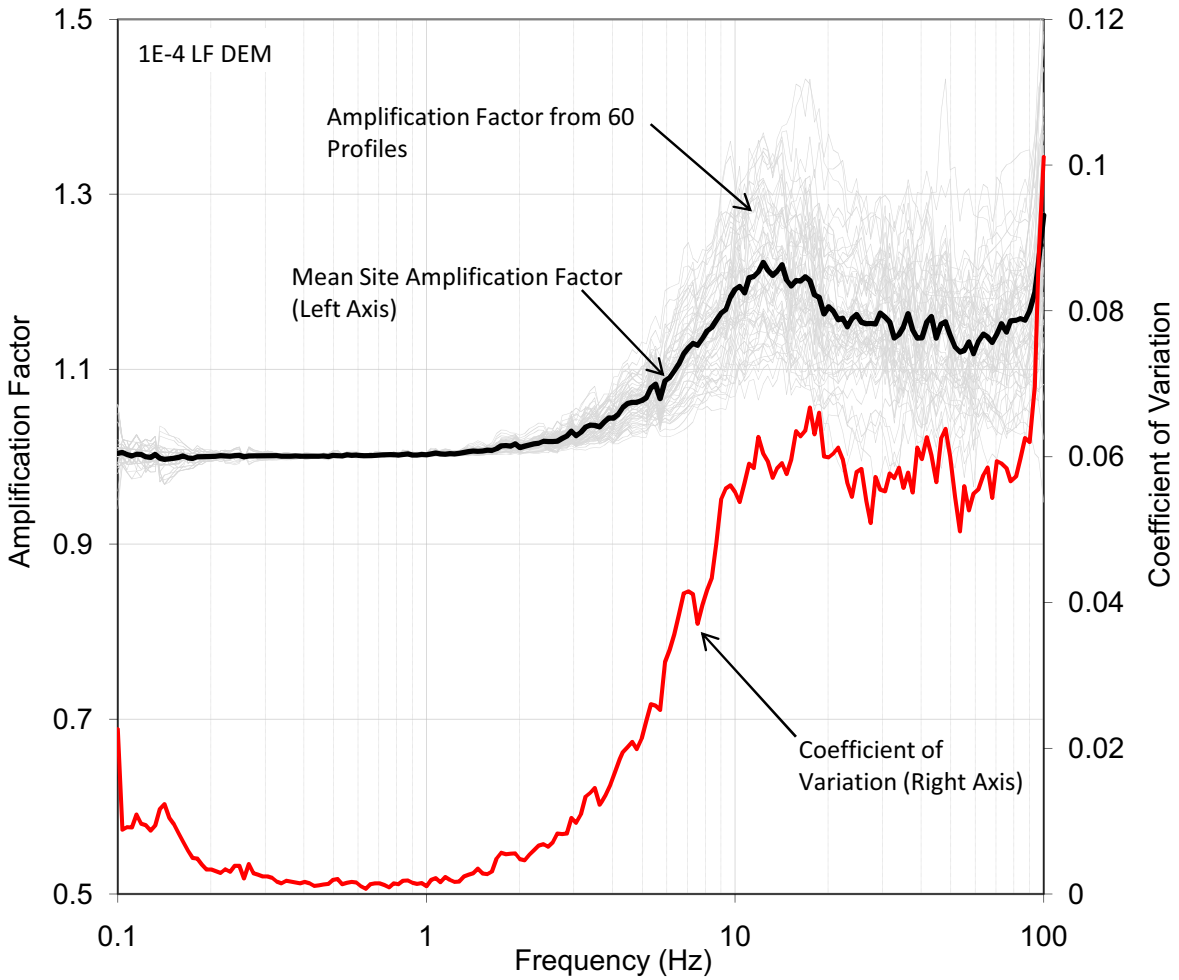

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Figure 2.5-59 {Maximum Strains Vs, Depth for 10^{-4} LF DEM Input Motion}

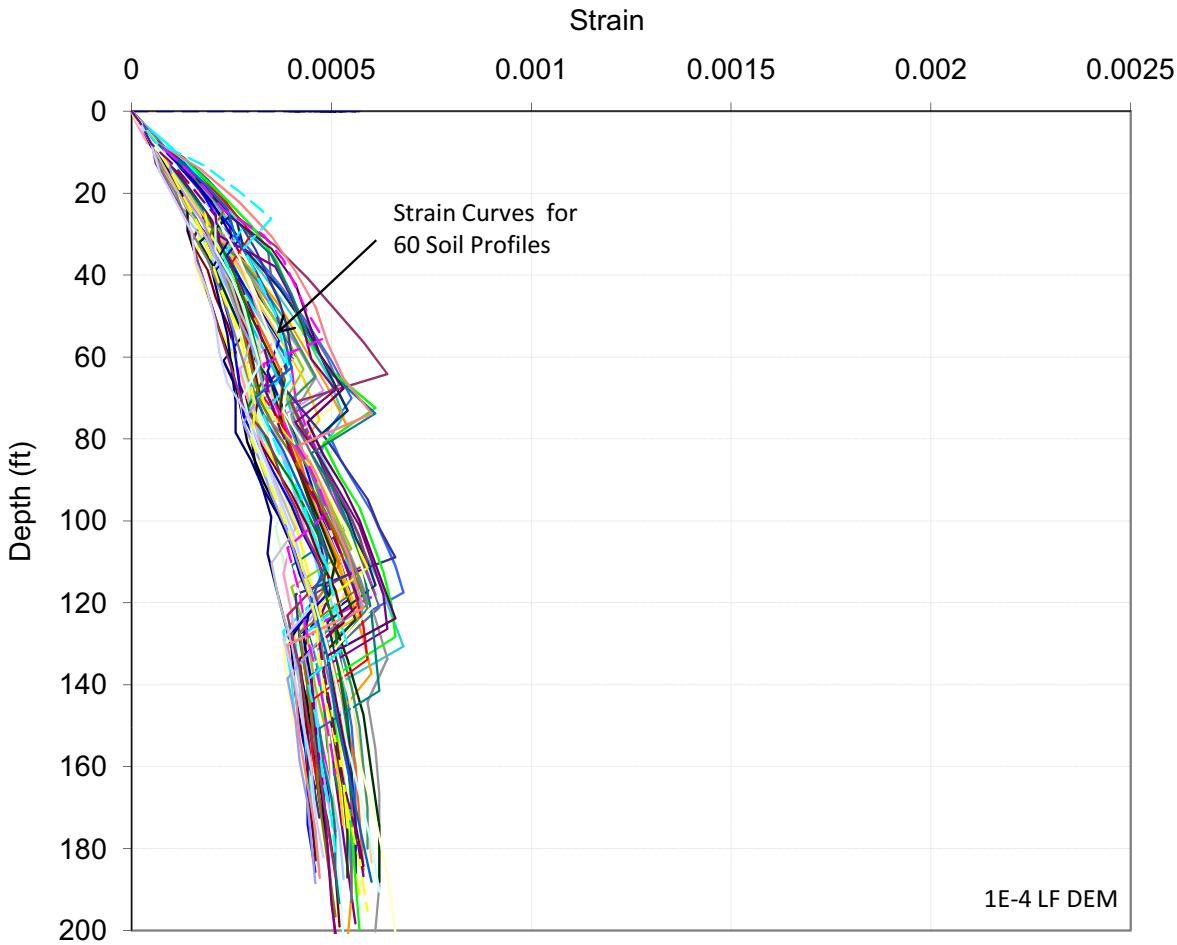

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Figure 2.5-60 {Mean Site Amplification Factor and Coefficient of Variation at the Top of Concrete for 10^{-5} HF DEM Input Motion}

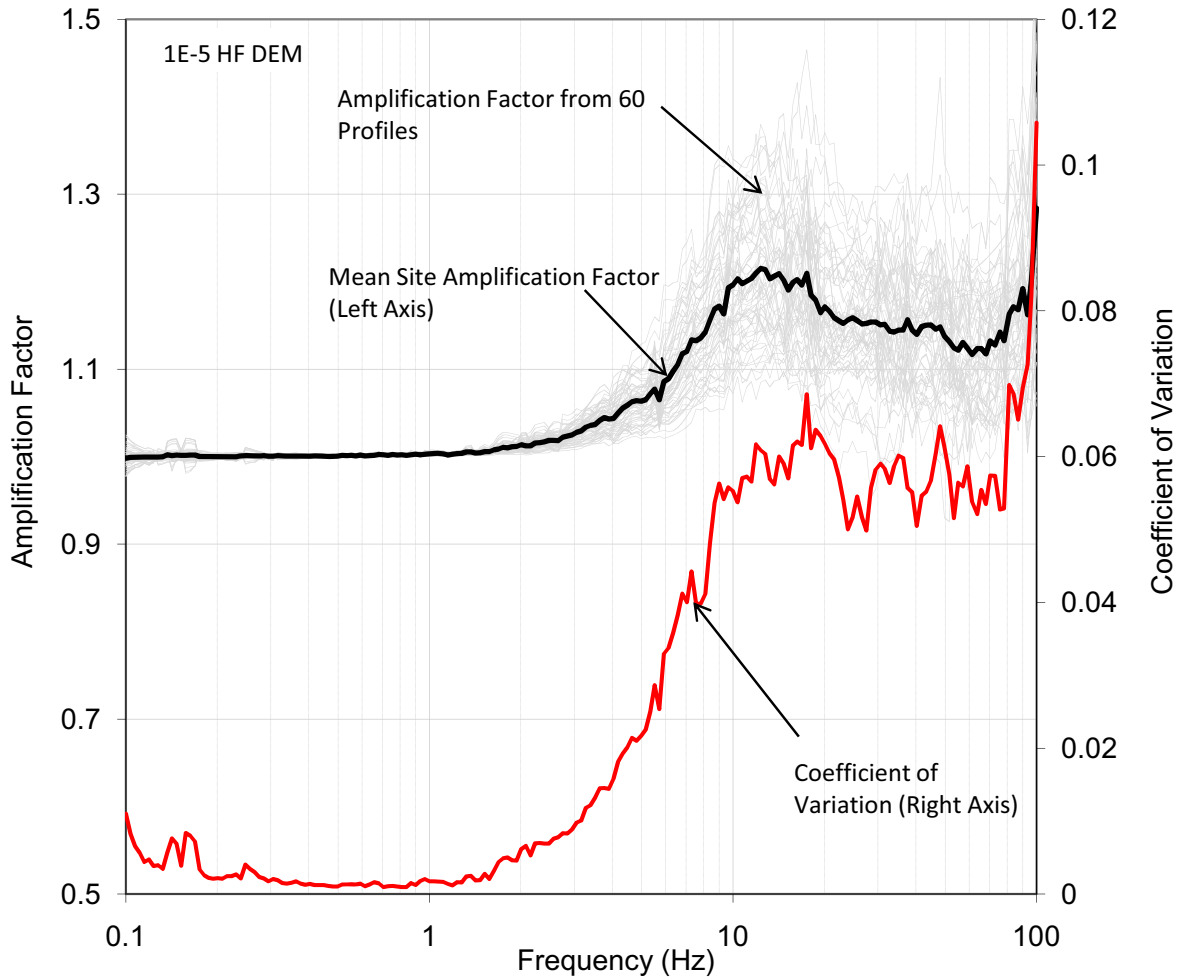

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Figure 2.5-61 {Maximum Strains Vs. Depth for 10^{-5} HF DEM Input Motion}

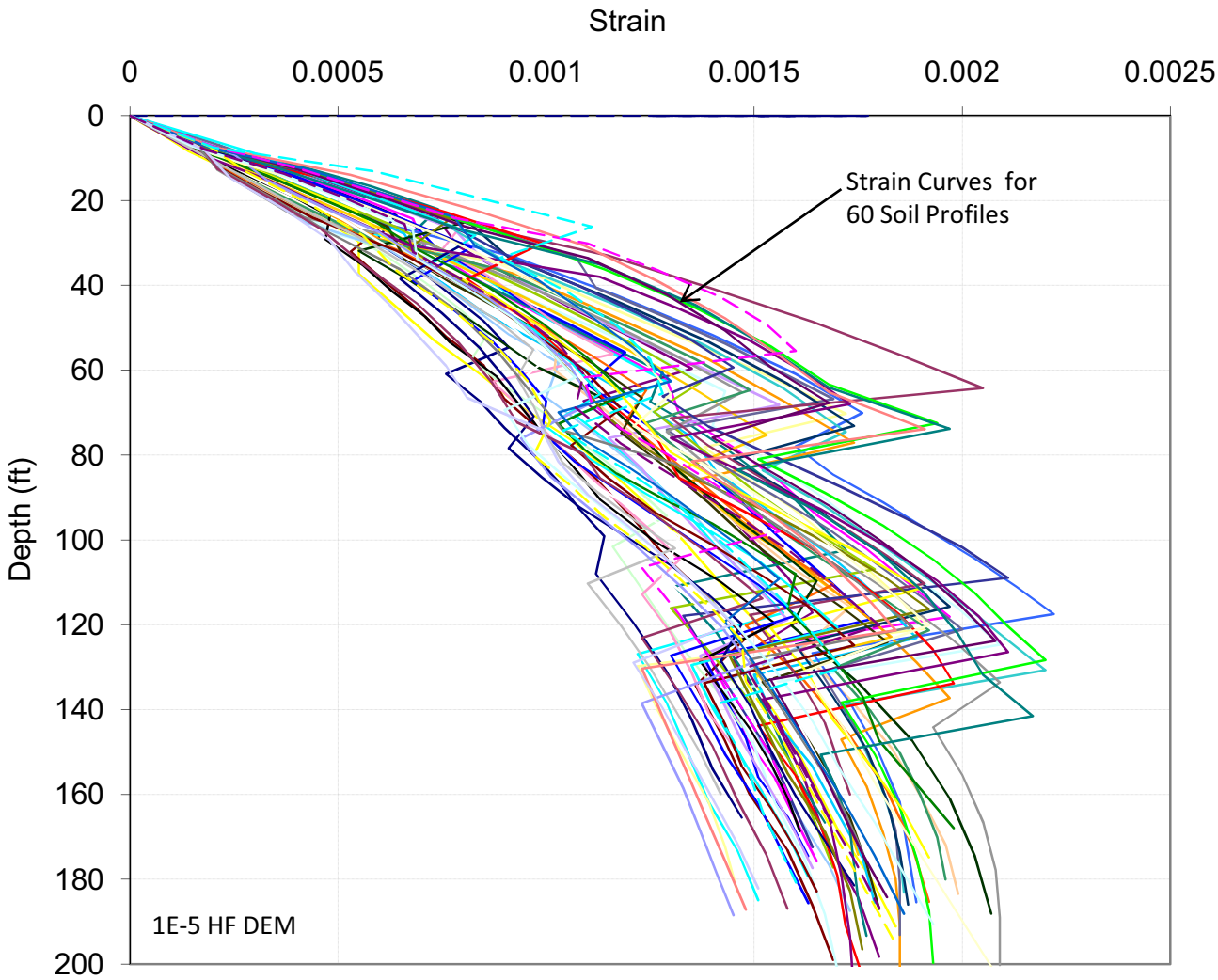

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Figure 2.5-62 {Mean Site Amplification Factor and Coefficient of Variation at the Top of Concrete for 10^{-5} LF DEM Input Motion}

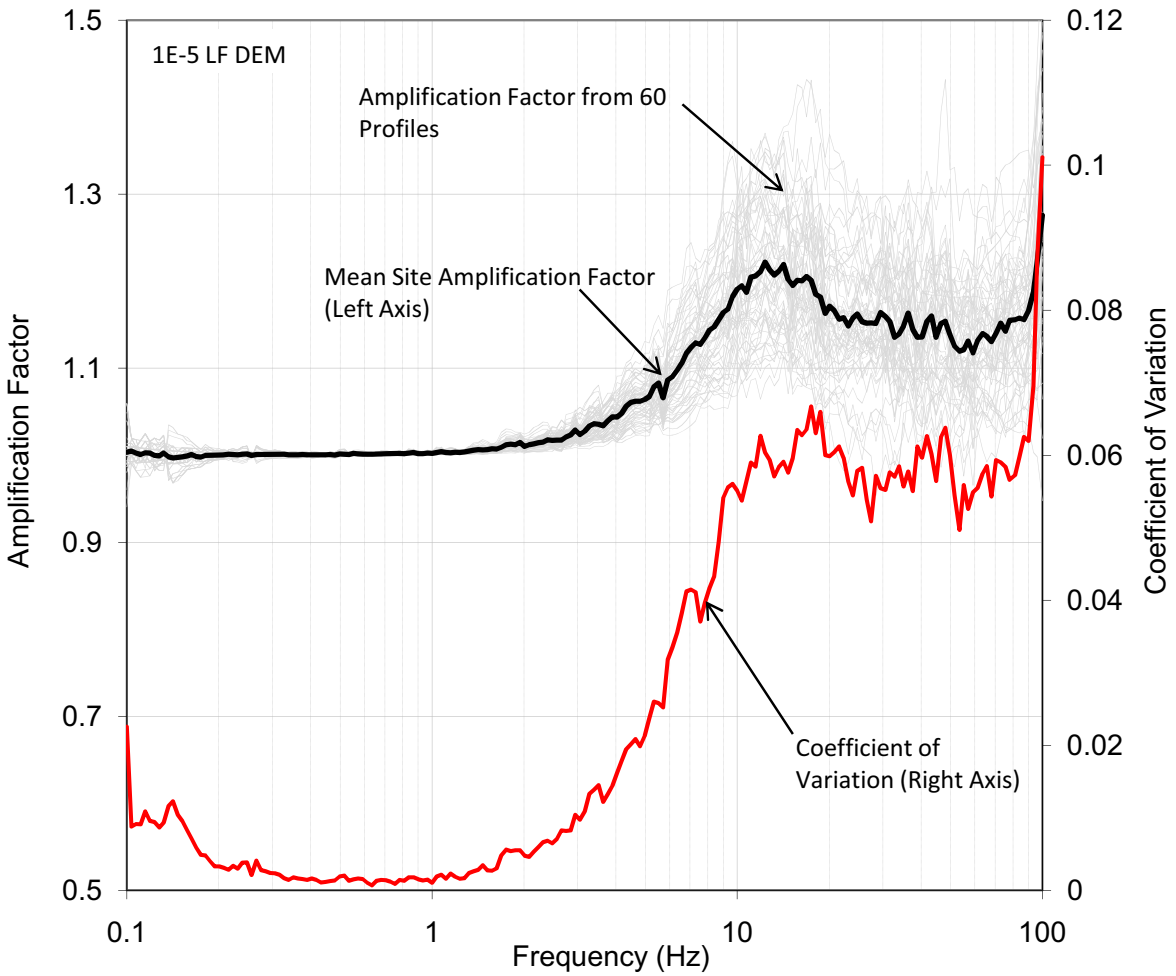

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Figure 2.5-63 {Maximum Strains Vs. Depth for 10^{-5} LF DEM Input Motion}

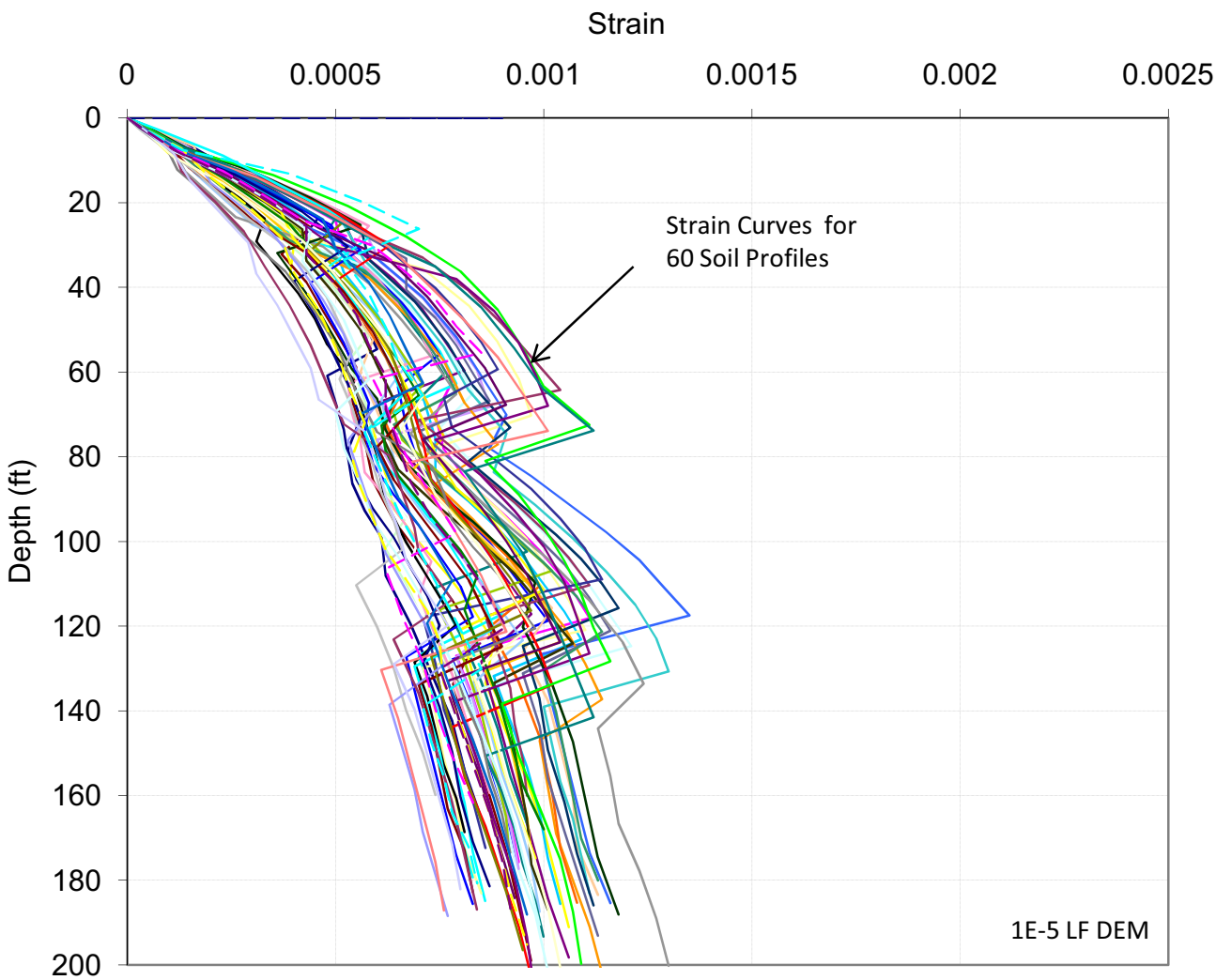

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Figure 2.5-64 {HF and LF Site Spectra, and Envelopes for 10^{-4} and 10^{-5}}

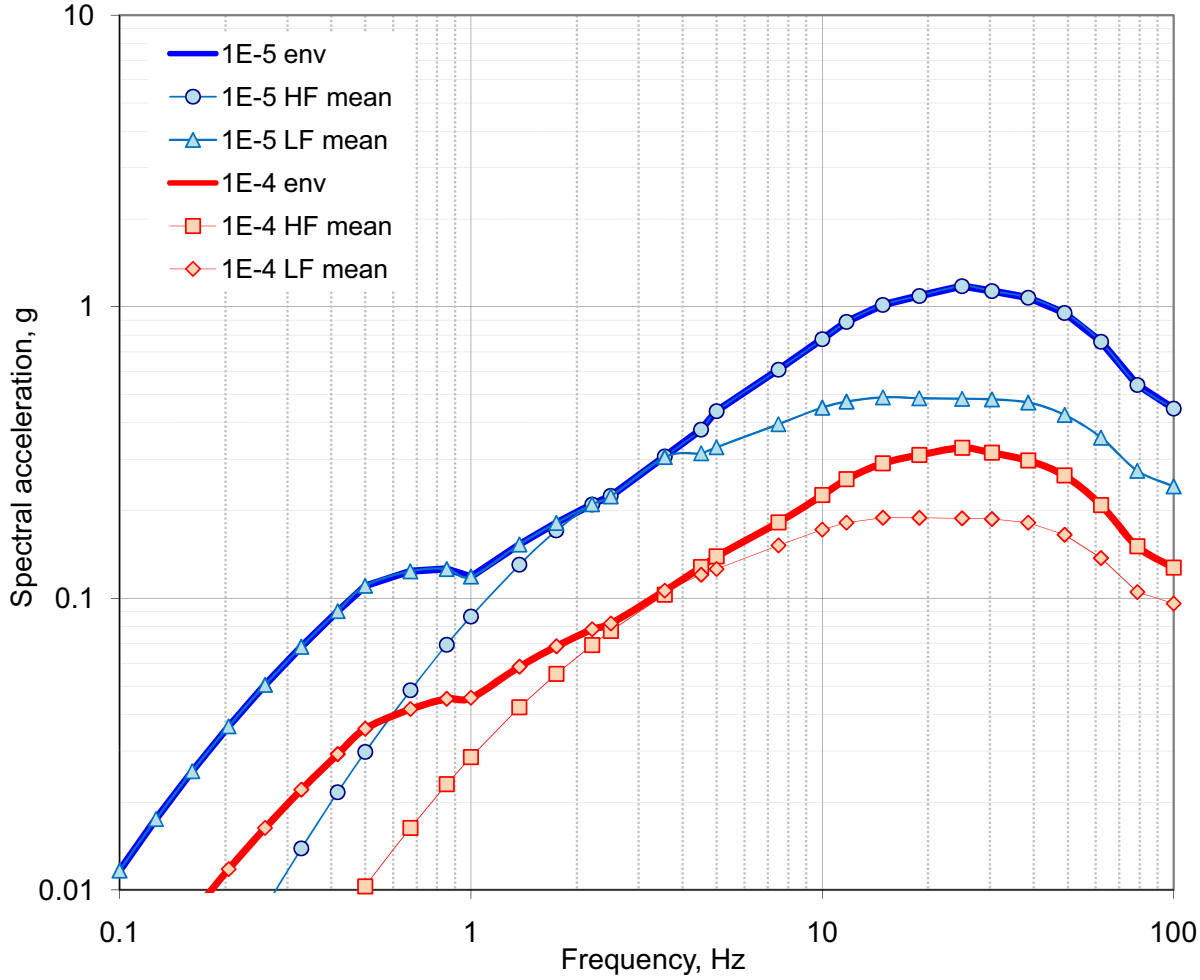

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Figure 2.5-65 {Recommended Horizontal and Vertical SSE Spectra}

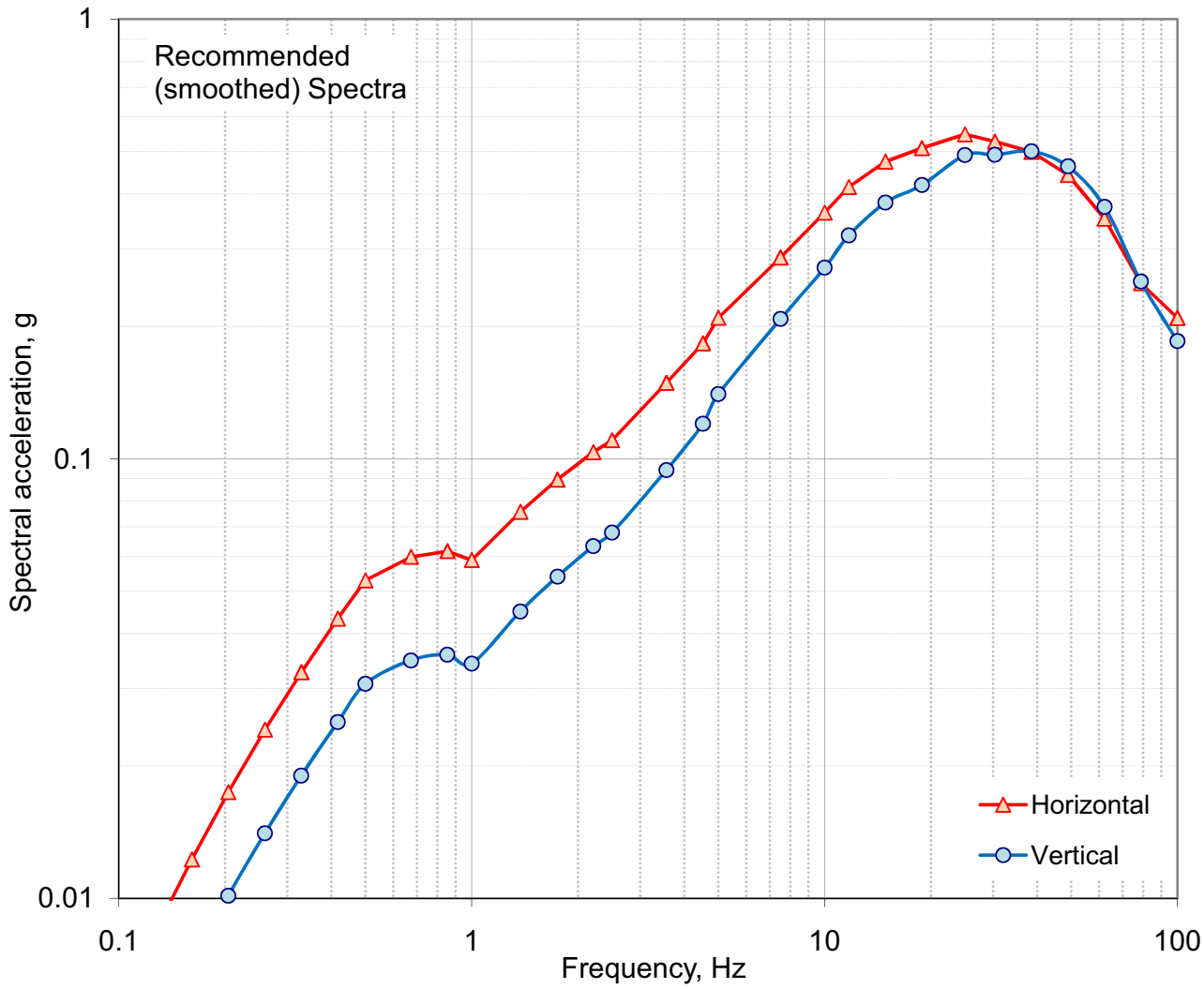

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Figure 2.5-66 {VH Ratios from Several Publications and Recommended VH Ratios}

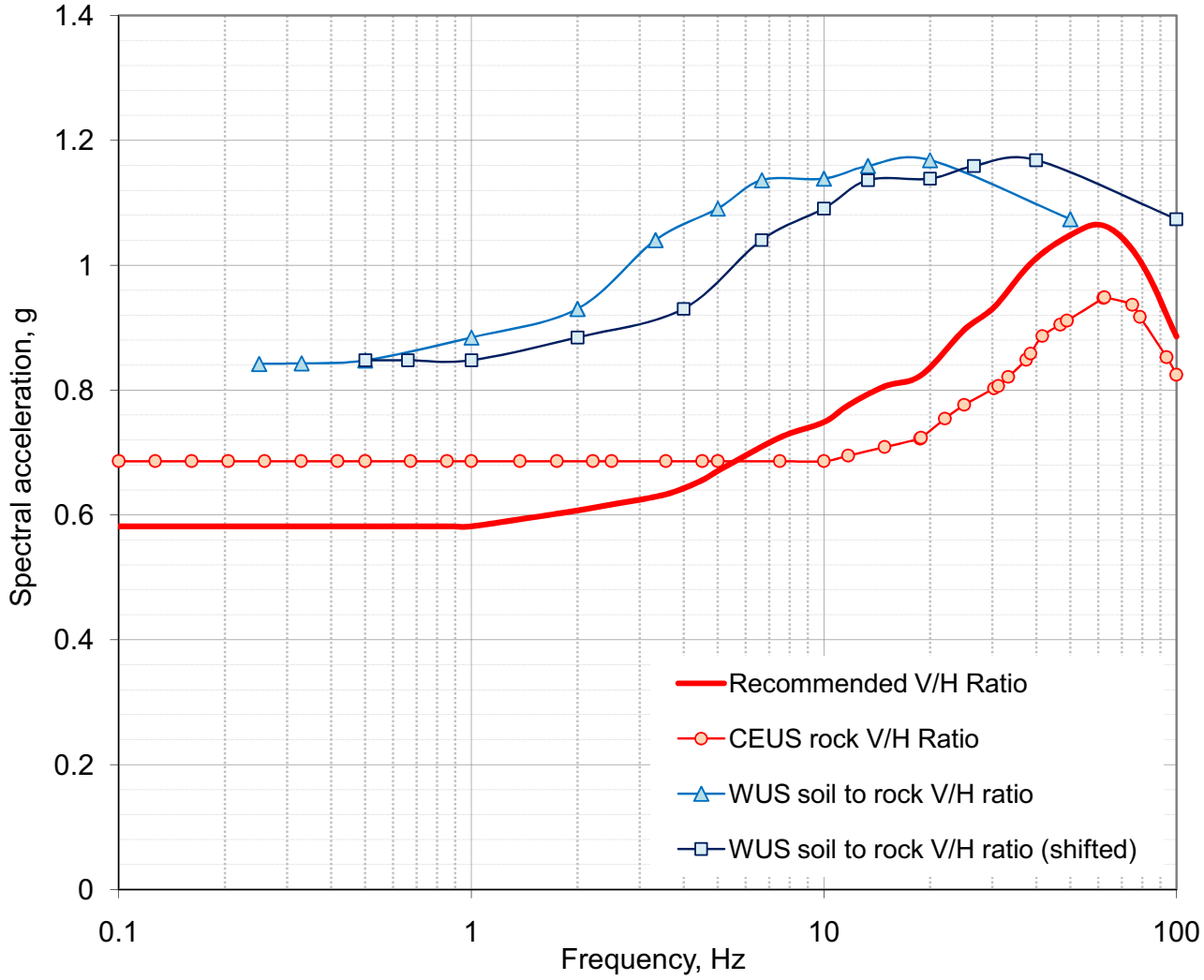

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Figure 2.5-67 {Mean and Fractile Rock Hazard Curves for PGA}

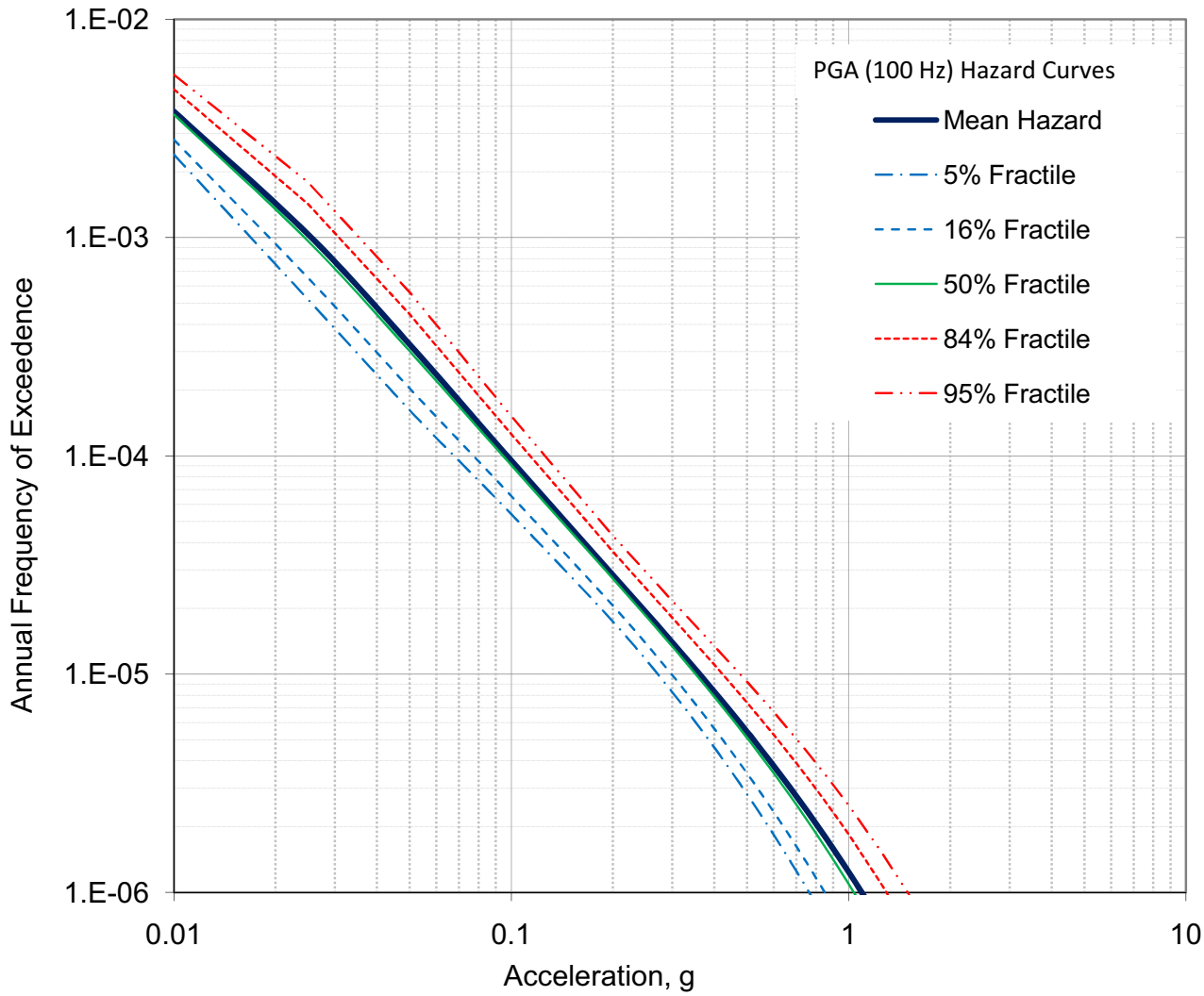

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Figure 2.5-68 {Mean and Fractile Rock Hazard Curves for 25Hz}

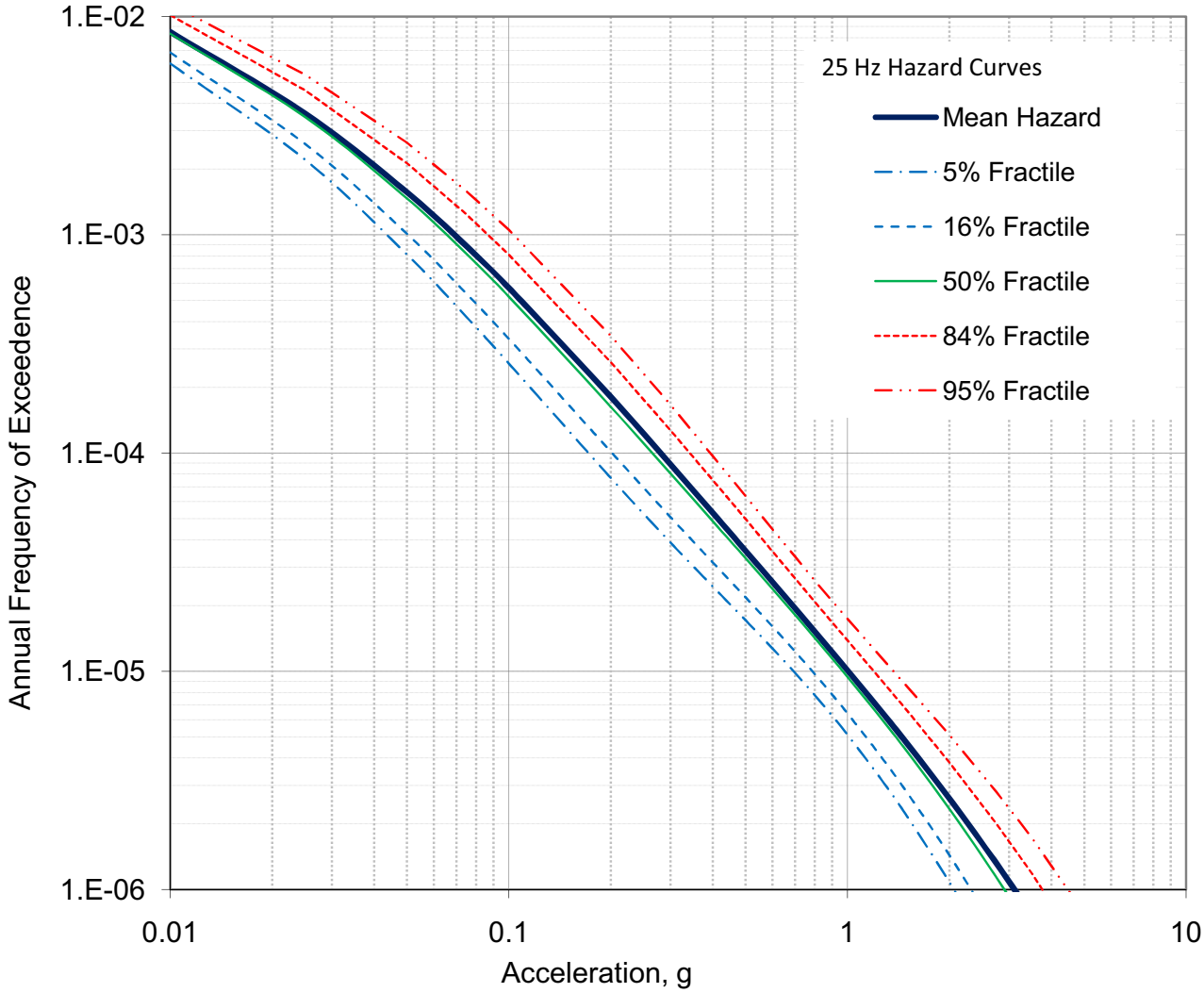

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Figure 2.5-69 {Mean and Fractile Rock Hazard Curves for 10 Hz}

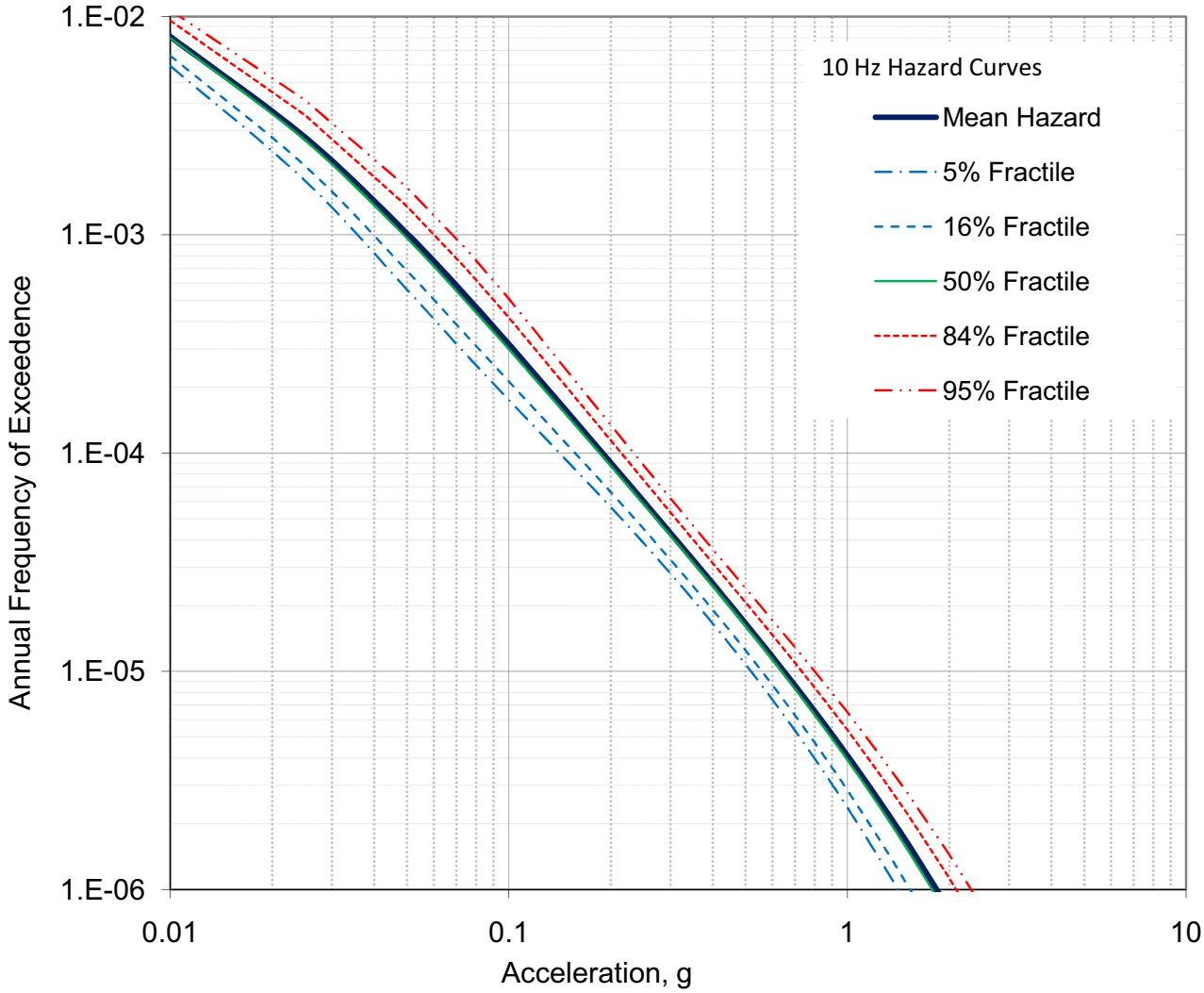

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Figure 2.5-70 {Mean and Fractile Rock Hazard Curves for 5.0 Hz}

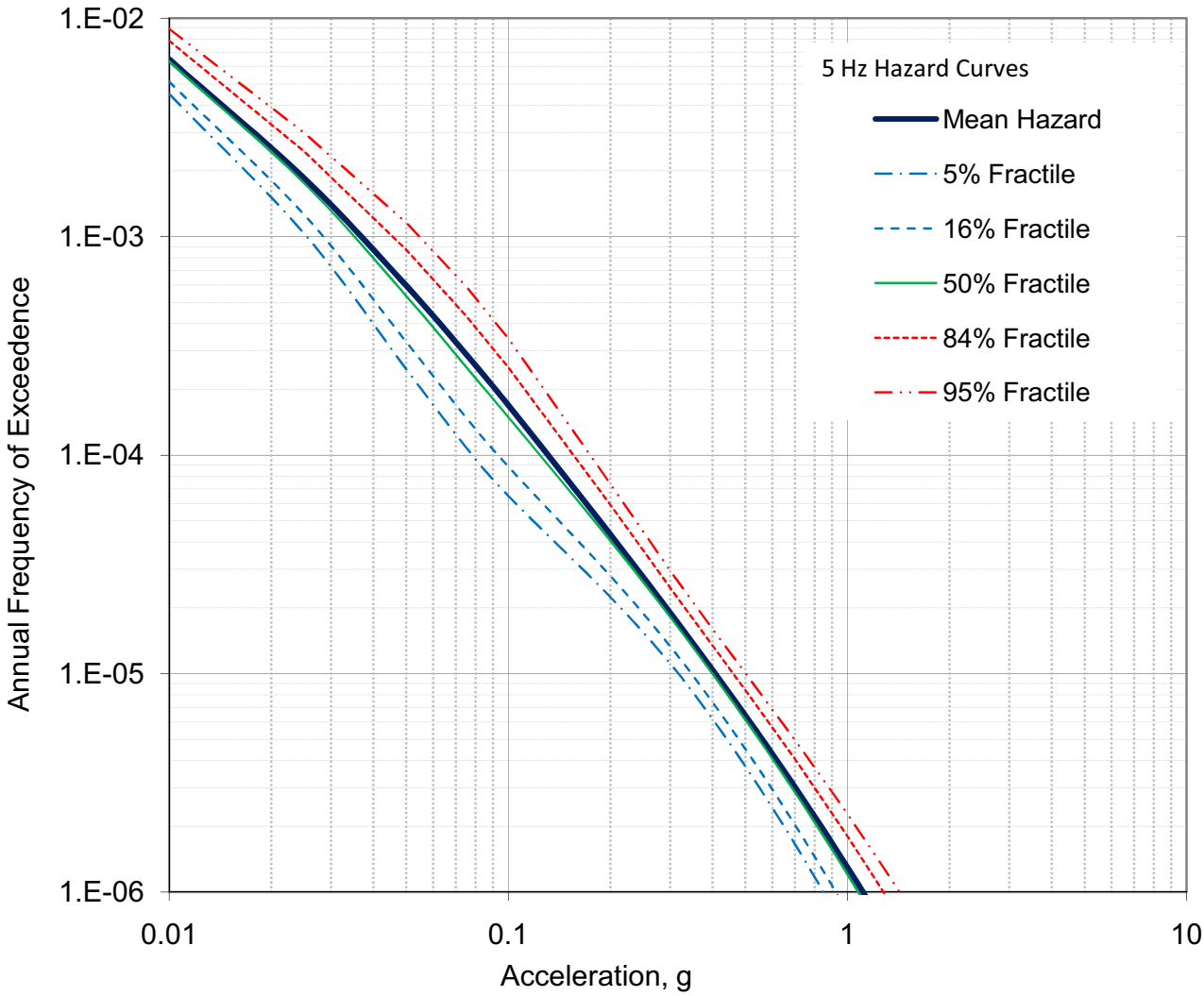

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Figure 2.5-71 {Mean and Fractile Rock Hazard Curves for 2.5 Hz}

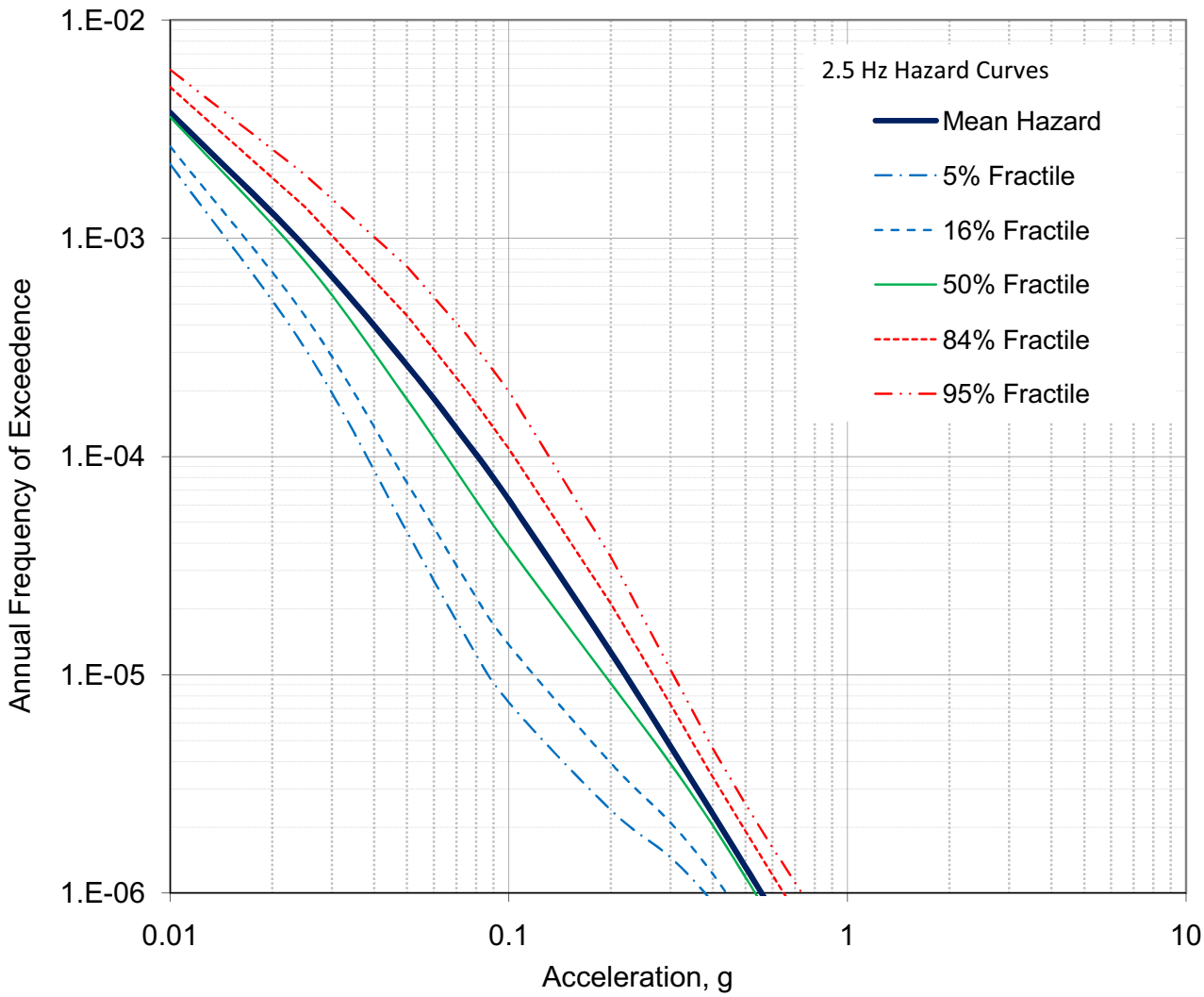

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Figure 2.5-72 {Mean and Fractile Rock Hazard Curves for 1.0 Hz}

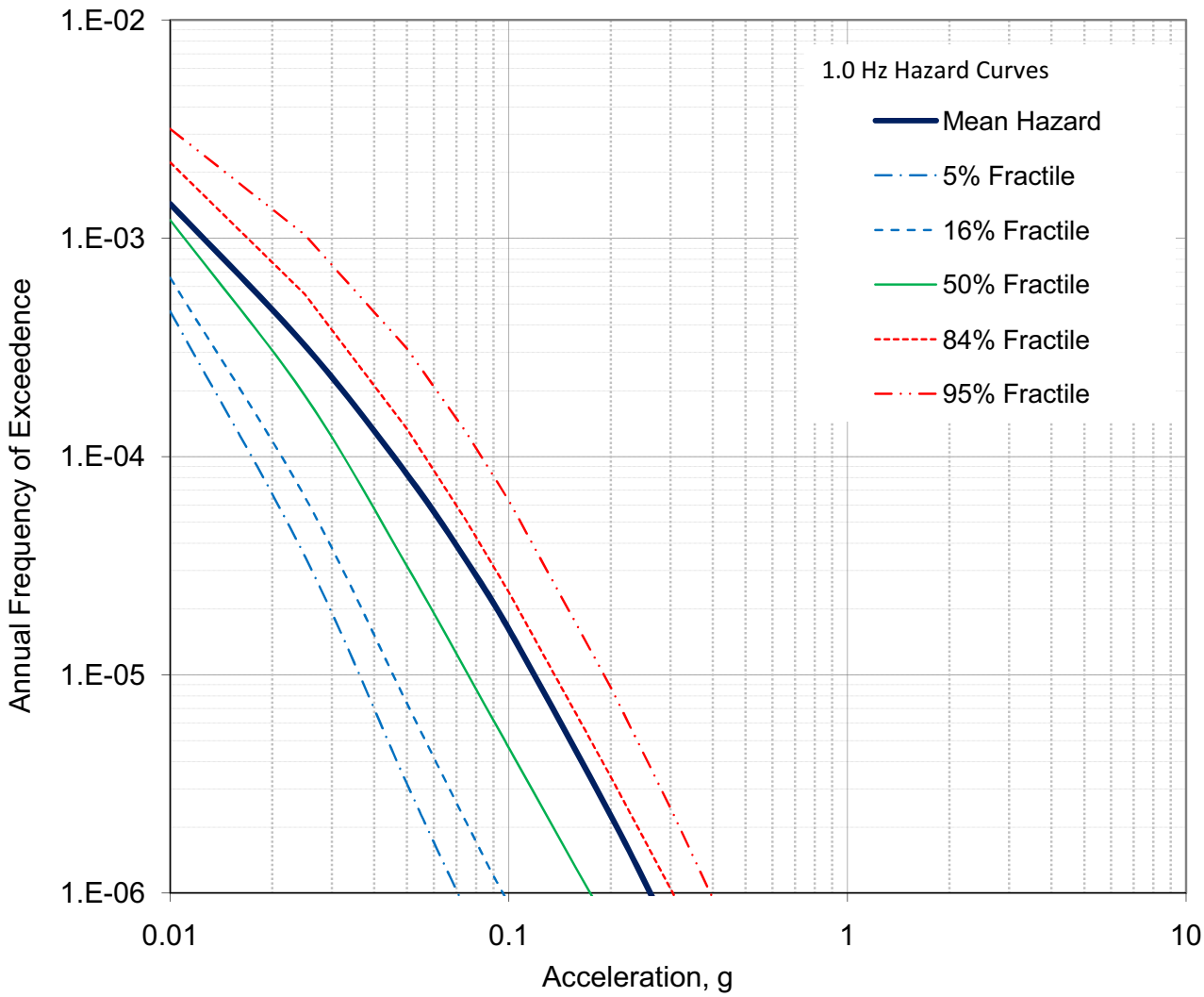

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Figure 2.5-73 {Mean and Fractile Rock Hazard Curves for 0.5 Hz}

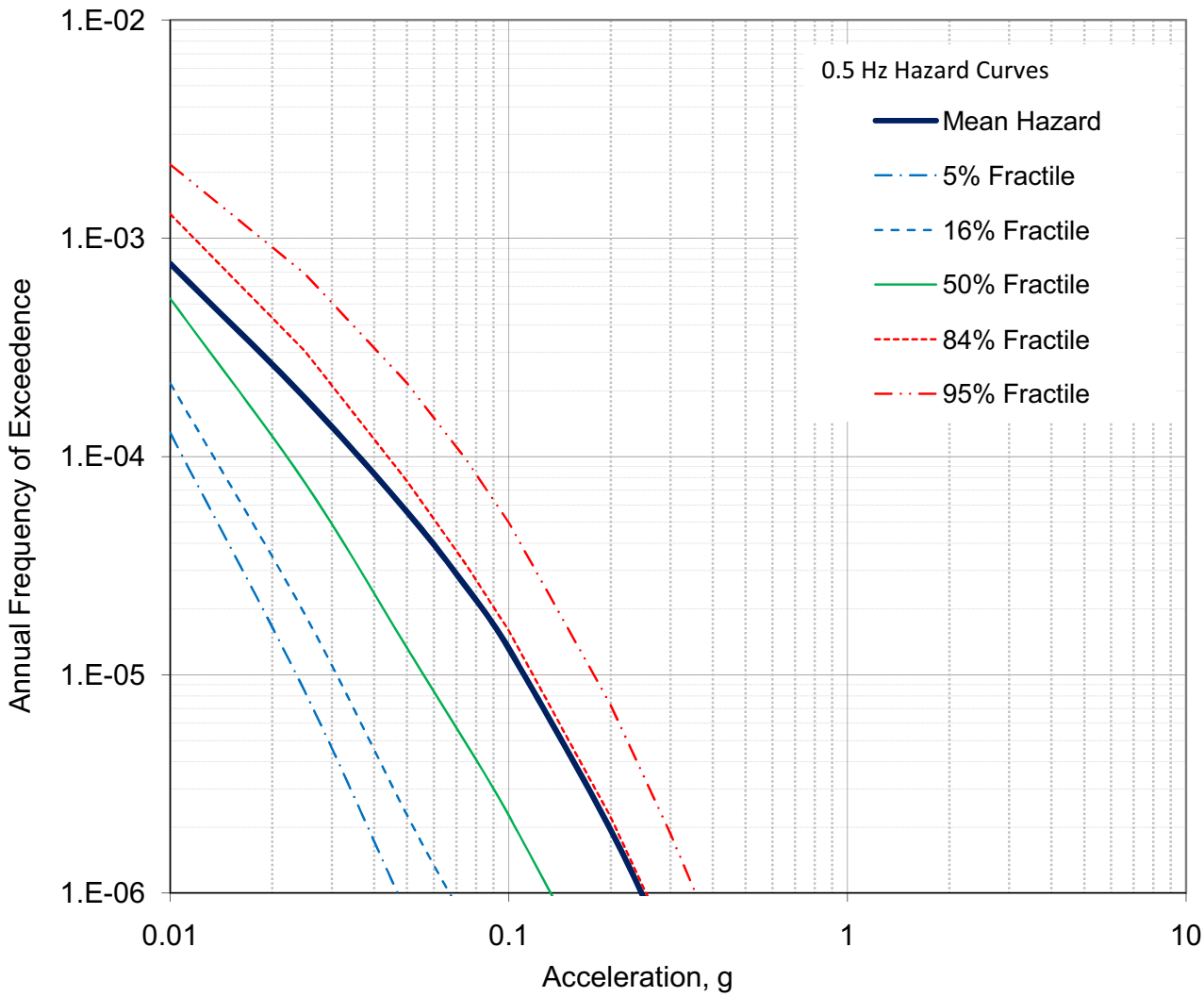

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Figure 2.5-74 {Location of the Arms of the New Madrid Fault System}

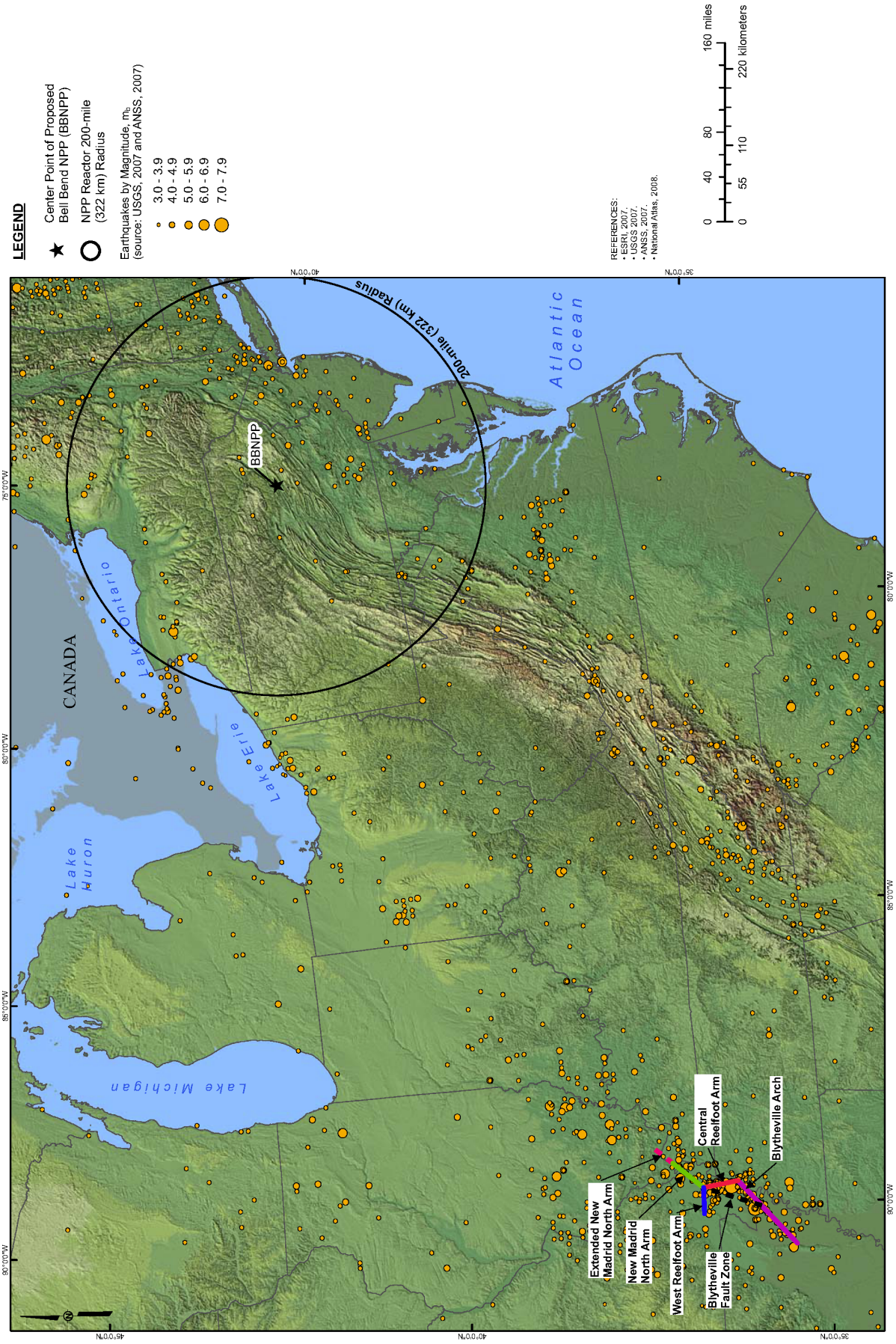

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Figure 2.5-75 {Logic Tree of Ground Motion Models fro Non-General Sources}

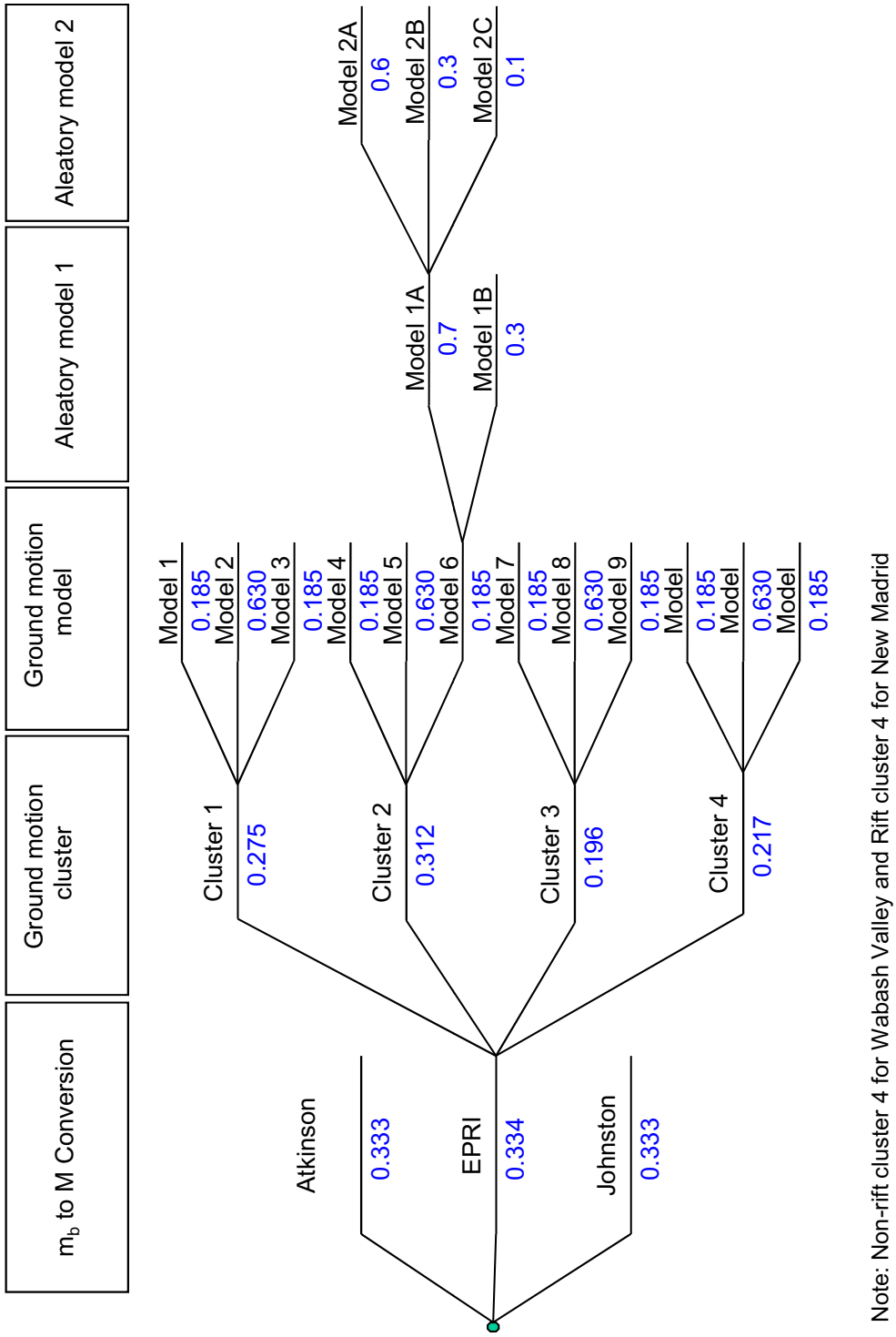

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Figure 2.5-76 {Logic Tree of Ground Motion Models for General Area Sources}

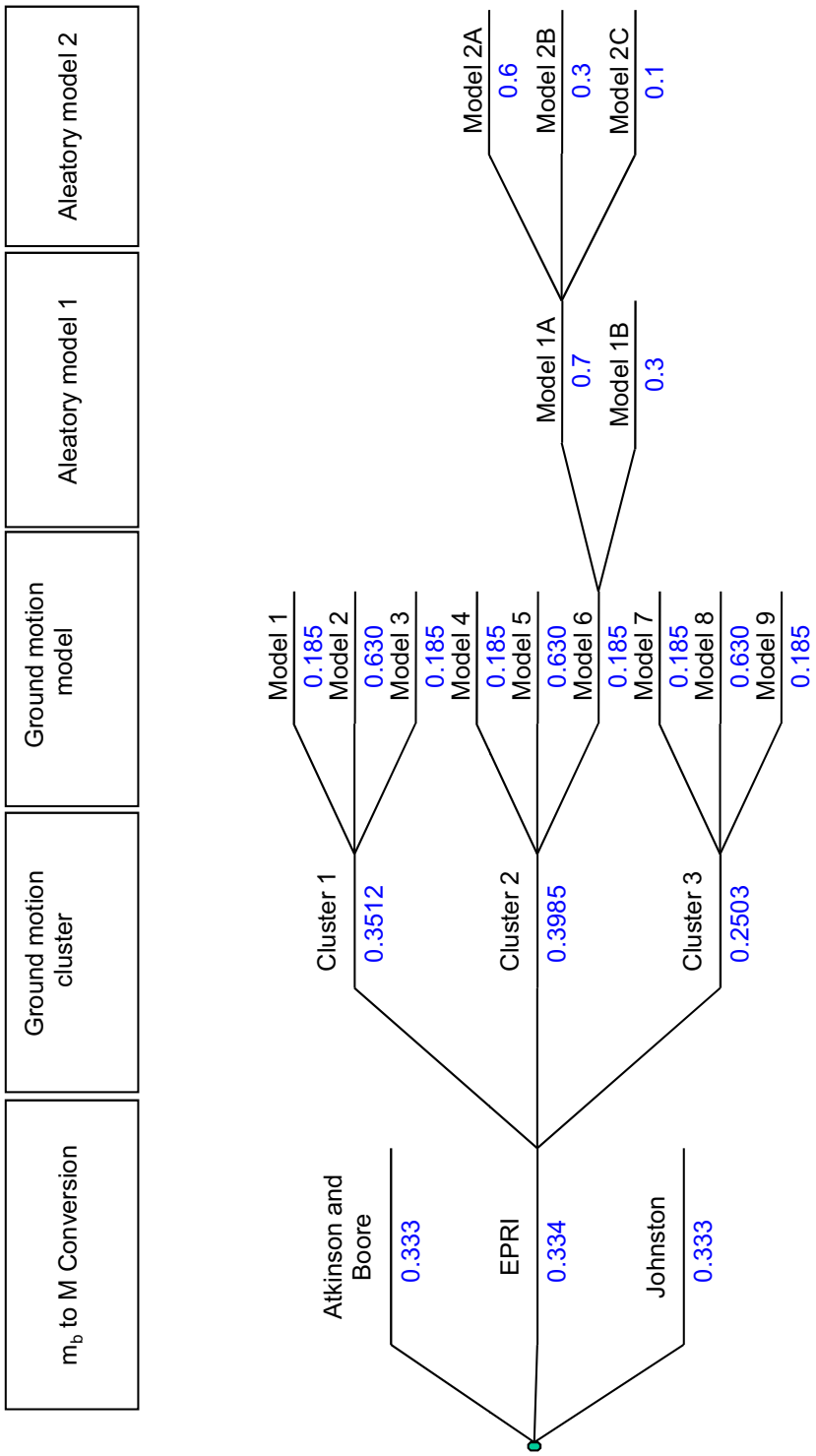

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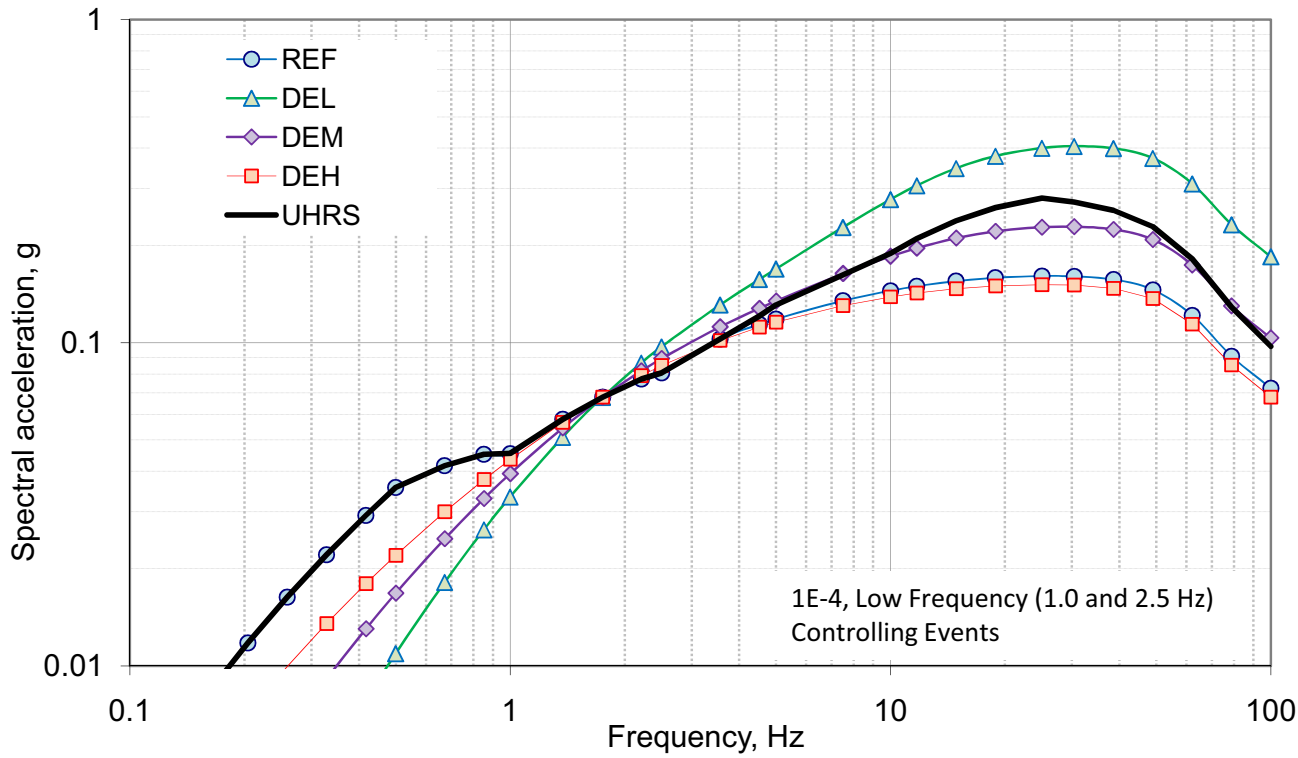
Figure 2.5-77 {10^{-4} Response Spectra of Controlling Events at BBNPP}



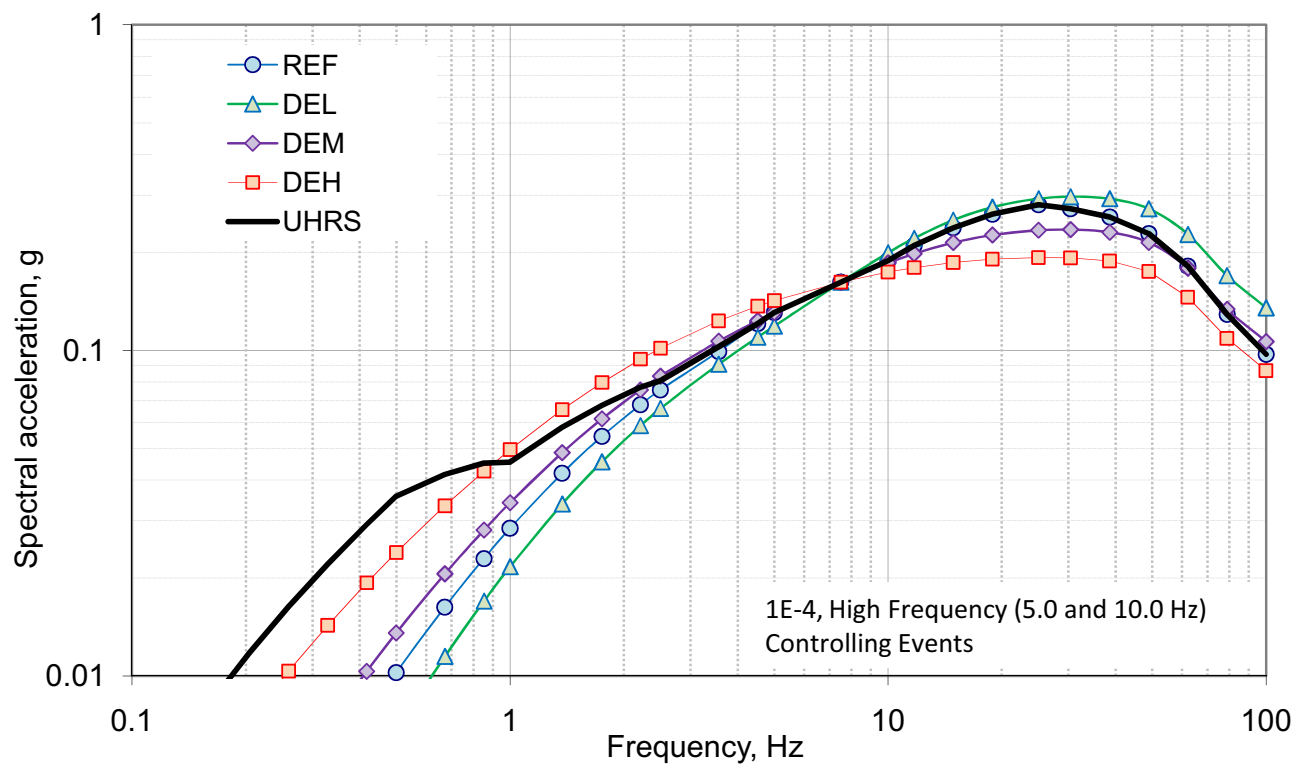


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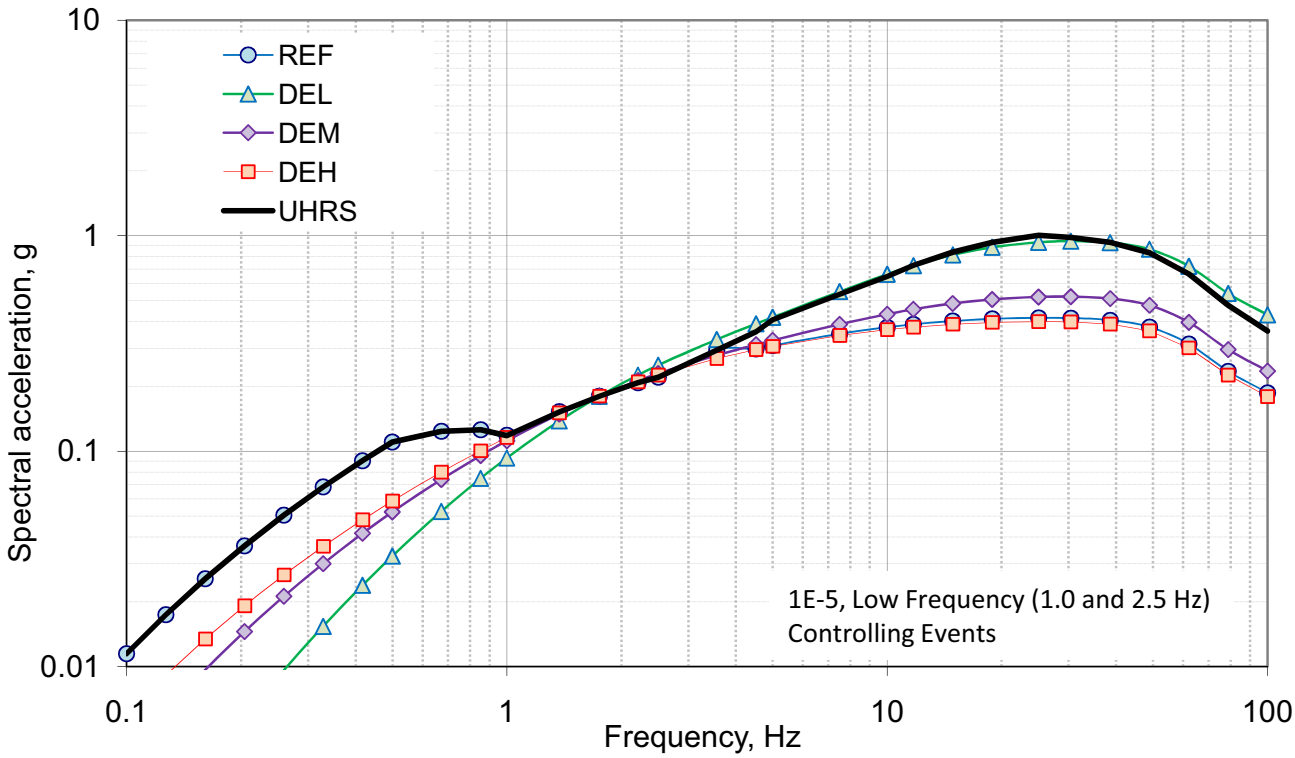
Figure 2.5-78 {10^{-5} Response Spectra of Controlling Events at BBNPP}



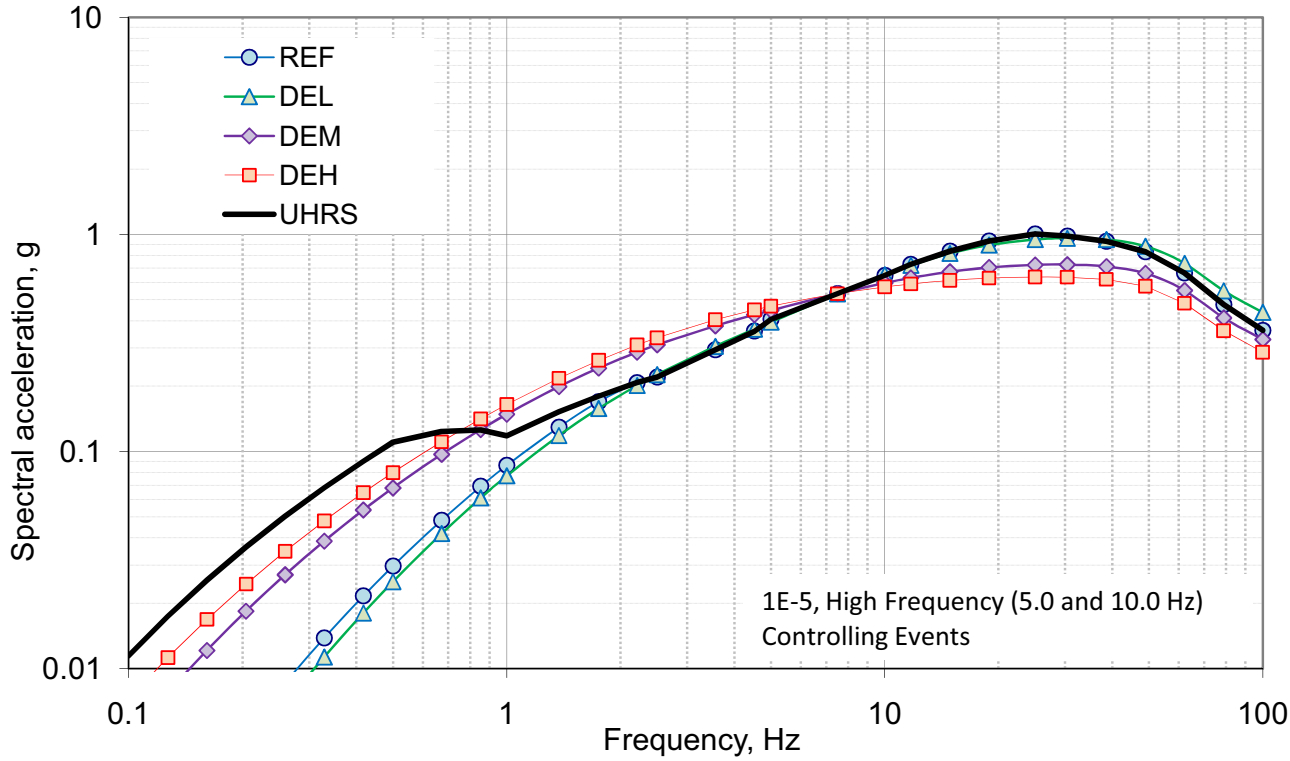


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Figure 2.5-79 {Response Spectra of Selected Time Histories for 10^{-4} Controlling Events LF, DEL and DEH after Spectral Matching}

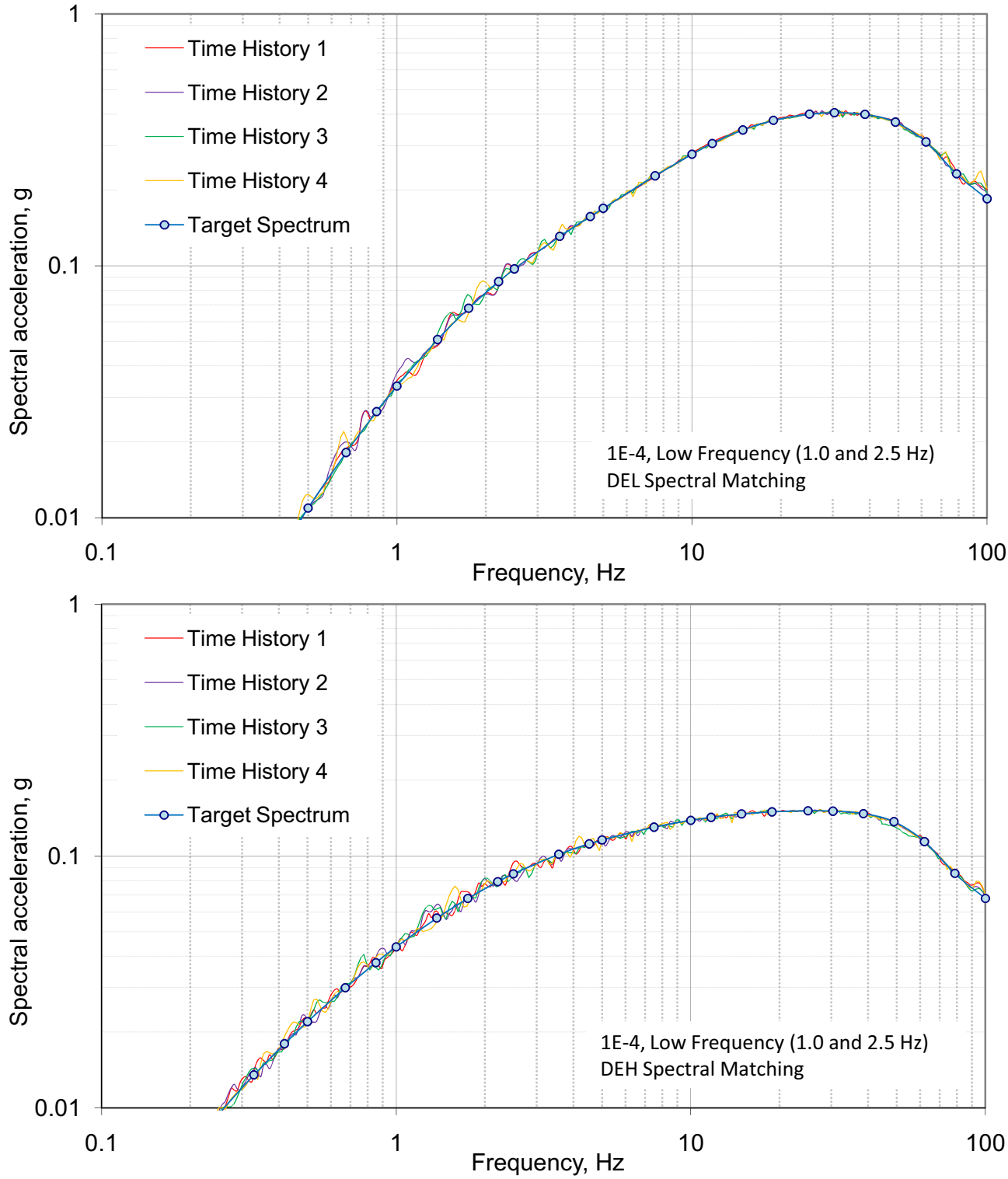

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Figure 2.5-80 {10^{-4} Smooth Hard Rock Reference Spectra}

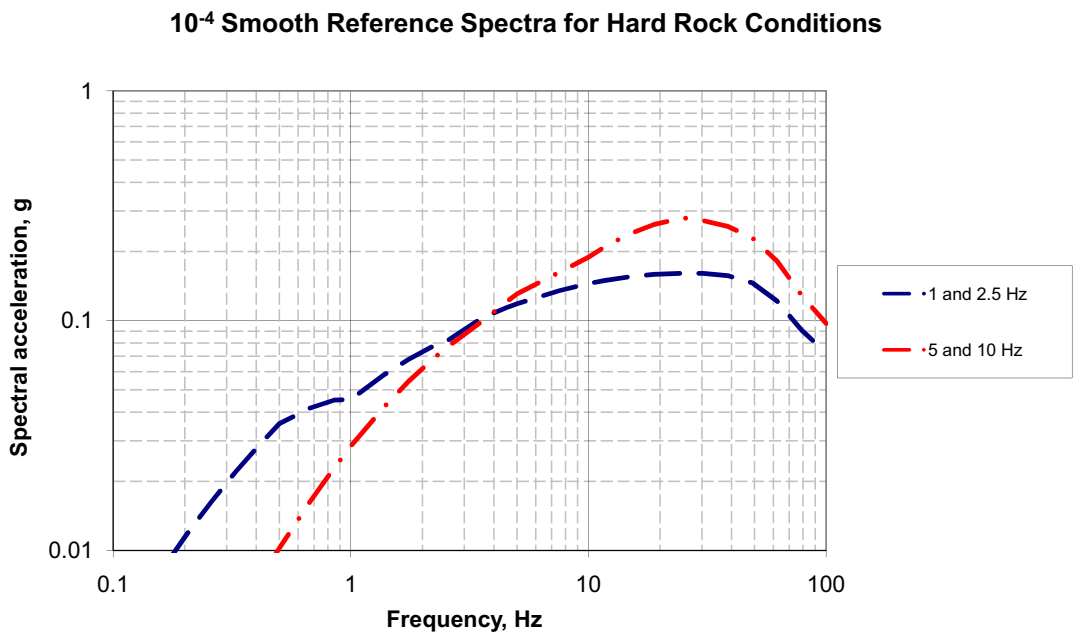

Figure 2.5-81 {Figure 2.5-81 10^{-5} Smooth Hard Rock Reference Spectra}

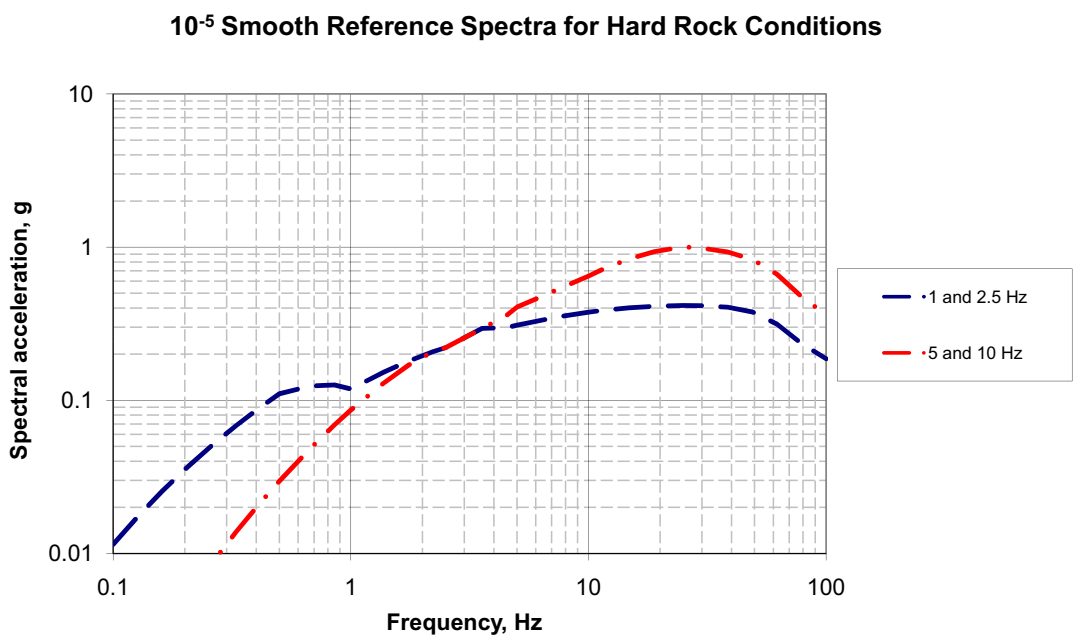

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Figure 2.5-82 {UCSS Map}

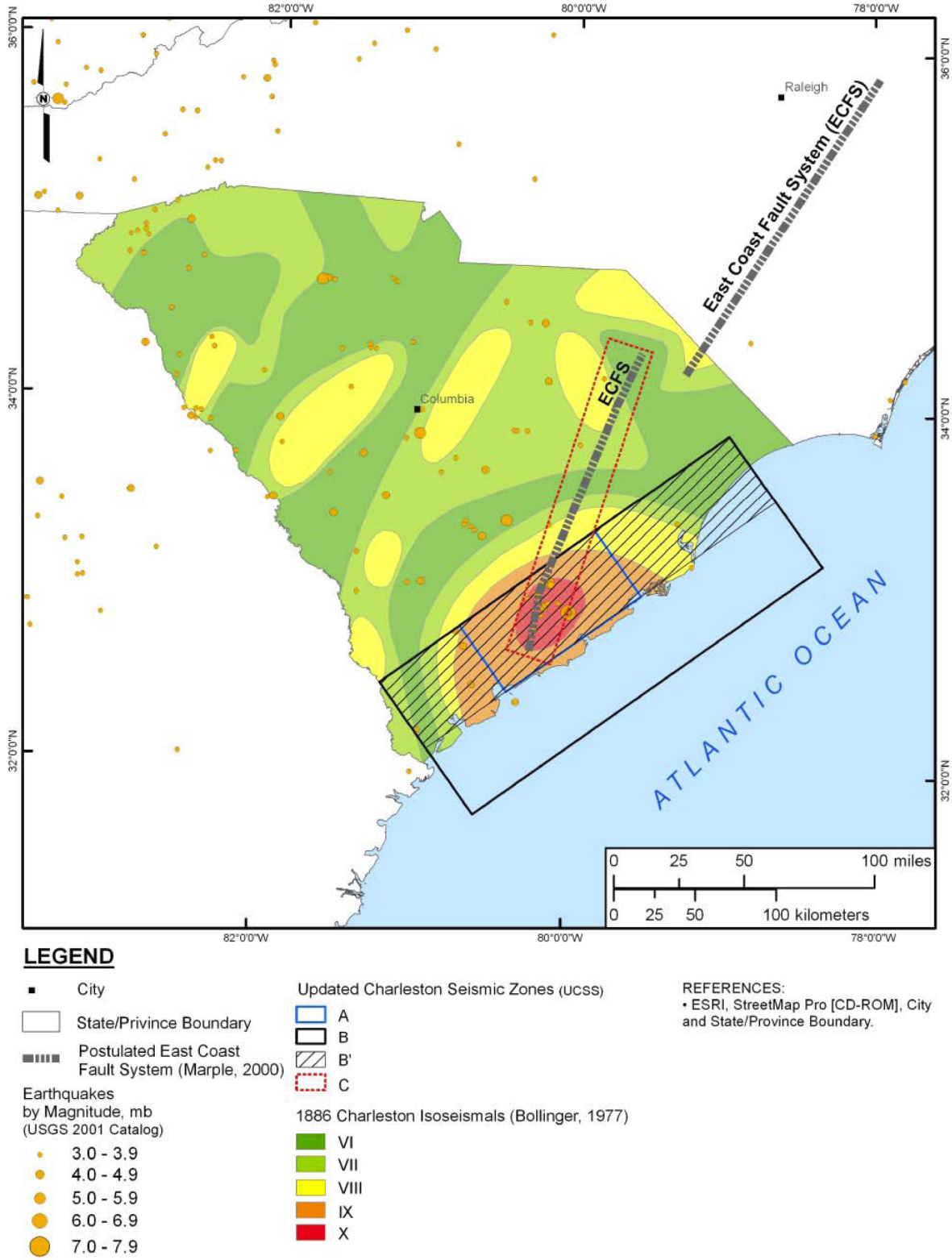

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Figure 2.5-83 {Updated Charleston Seismic Sources (UCSS) Logic Tree}

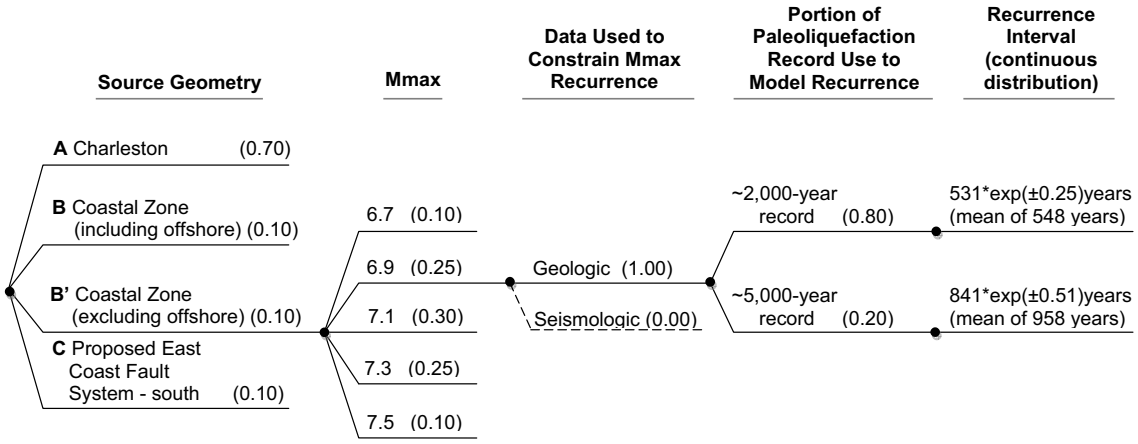

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Figure 2.5-84 {Comparison Vs Profiles Between 10 Generic S l Profiles and Average BBNPP Profile}

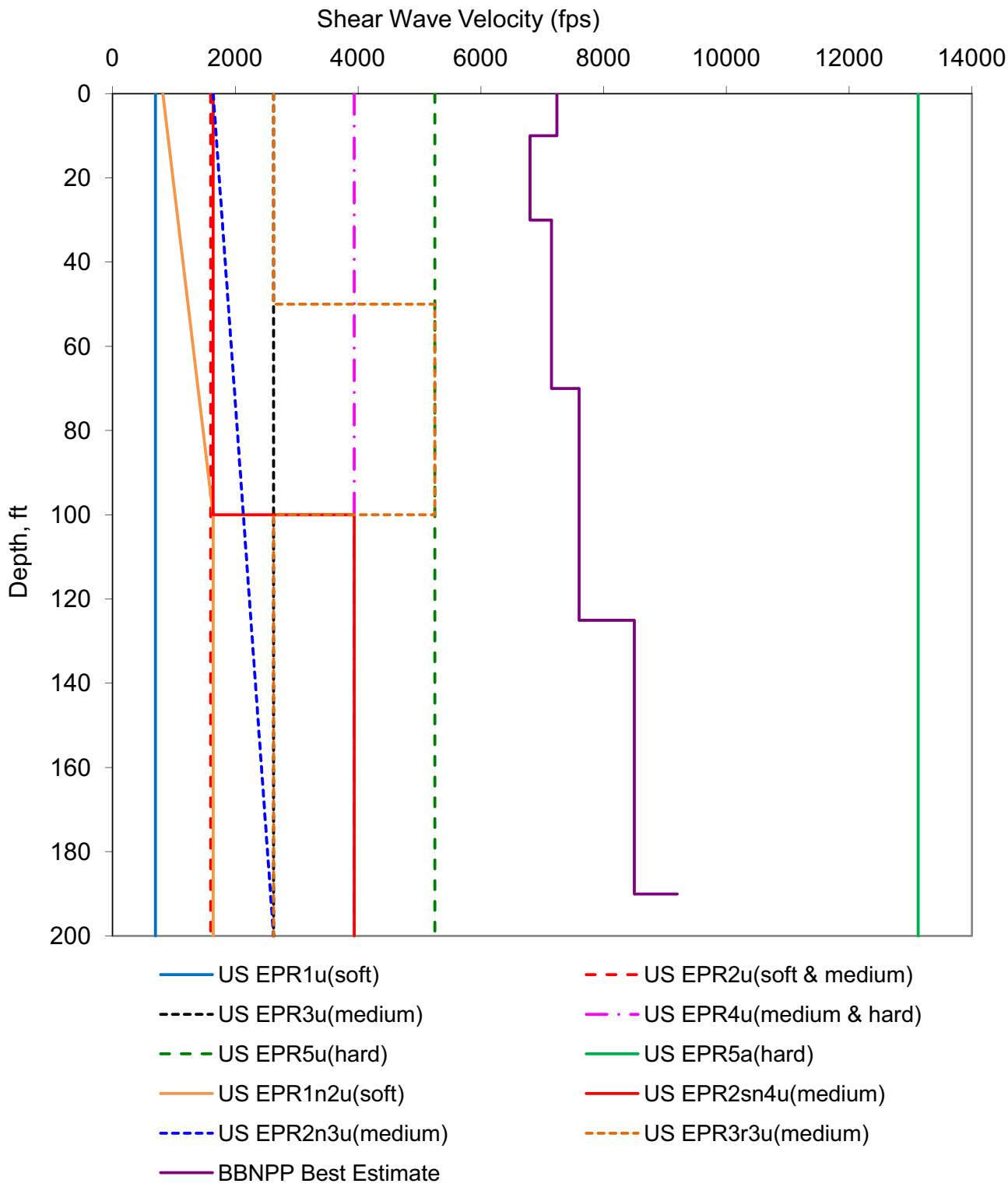

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Figure 2.5-85 {Mean 10^{-6} Rock Deaggregation for 1 and 2.5 Hz}

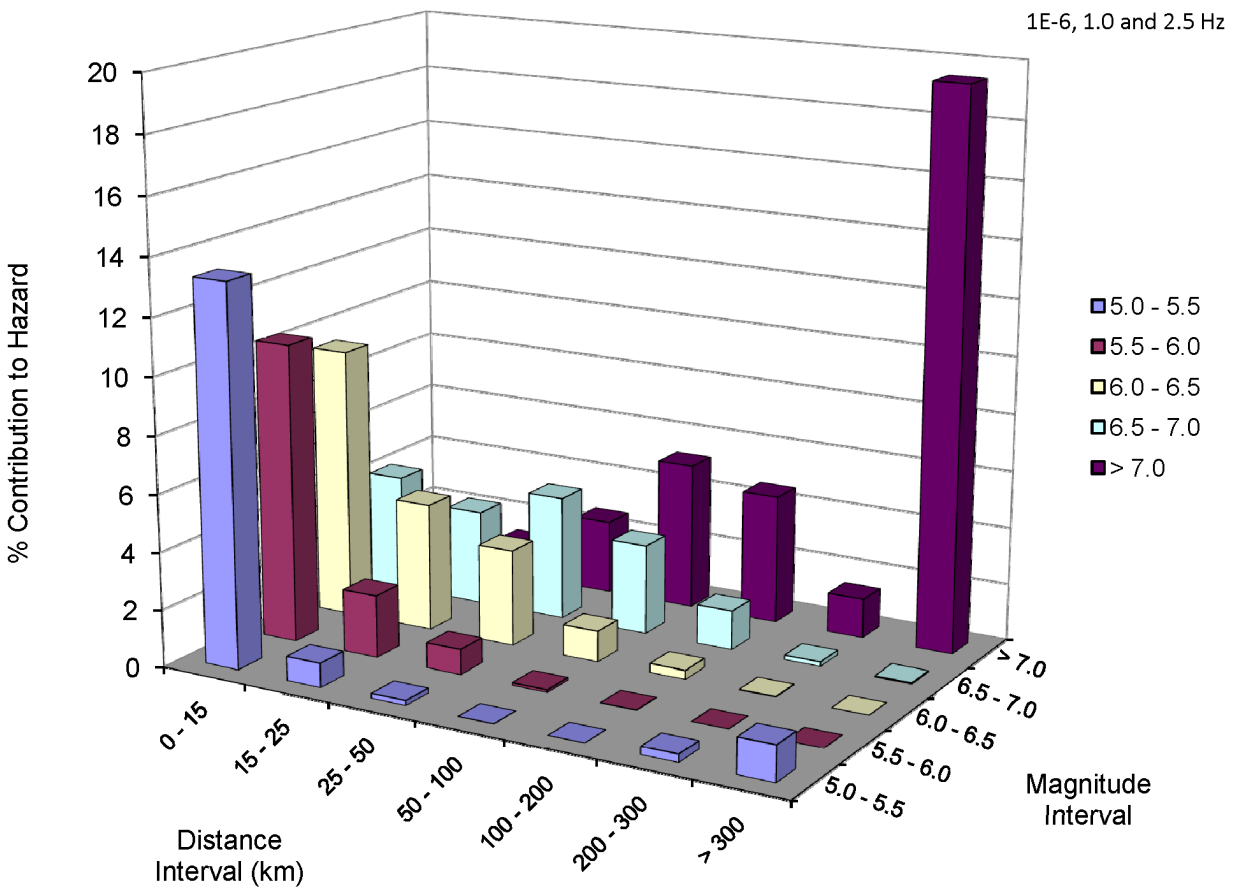

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Figure 2.5-86 {Mean 10^{-6} Rock Deaggregation for 5 and 10 Hz}

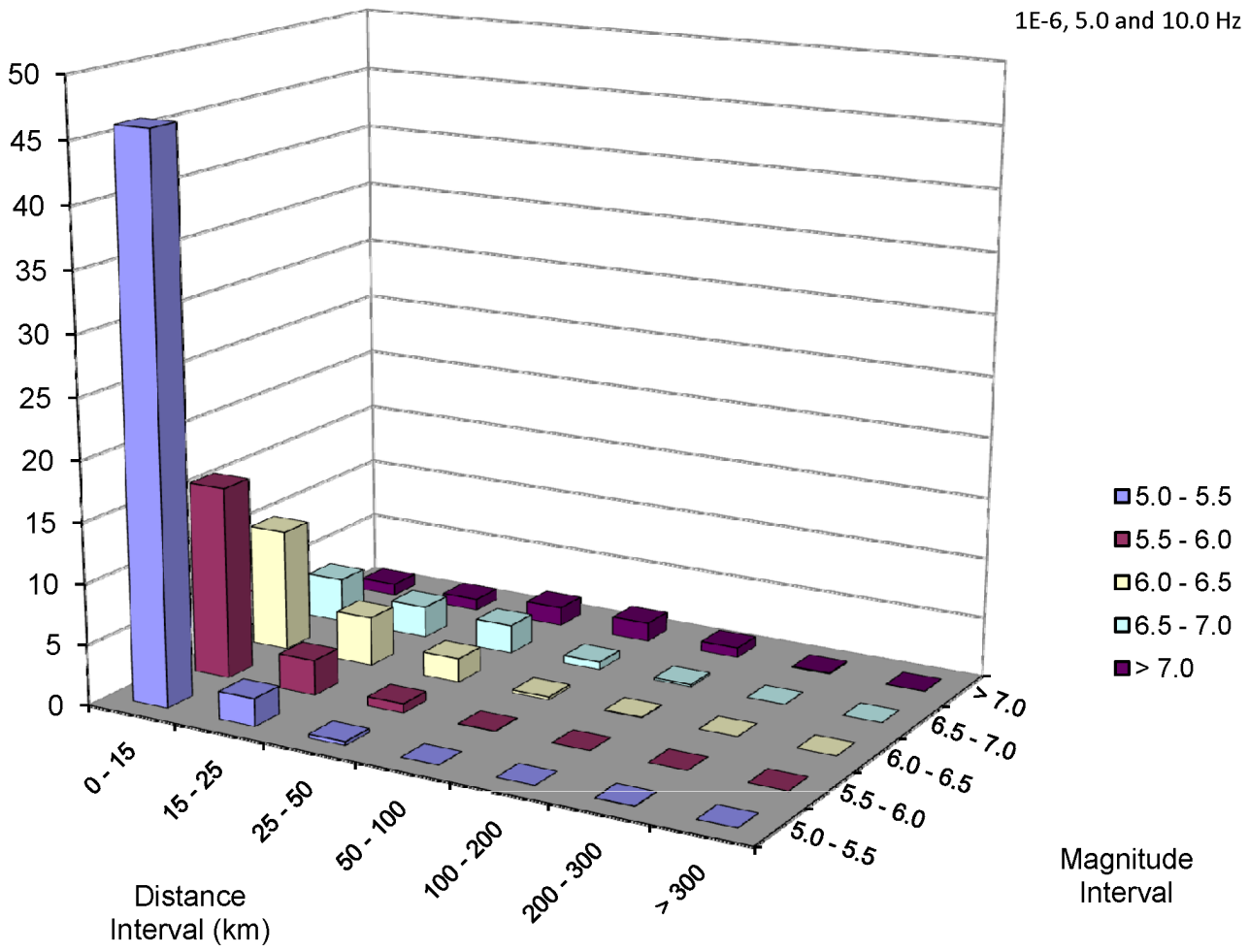

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Figure 2.5-87 {Bechtel EPRI Source Zones and 2002-2007 Events in 500-Mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 500-mile (805 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie/Charlevoix
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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Figure 2.5-88 {Dames and Moore EPRI Source Zones and 2002-2007 Events in 500-mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 500-mile (805 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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Figure 2.5-89 {Law Engineering EPRI Source Zones and 2002-2007 Events in 500-Mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 500-mile (805 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

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Figure 2.5-90 {Rondout Associates EPRI Source Zones and 2002-2007 Events in 500-Mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 500-mile (805 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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Figure 2.5-91 {Weston Geophysical EPRI Source Zones and 2002-2007 Events in 500-Mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 500-mile (805 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 28B Zone of Mesozoic Basin
- 28E Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

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Figure 2.5-92 {Woodward-Clyde EPRI Source Zones and 2002-2007 Events in 500-Mile Radius}

LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 500-mile (805 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2002 to 2007

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 25 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 61 Tyron-Mt. Union Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 63 Pittsburgh-Washington Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

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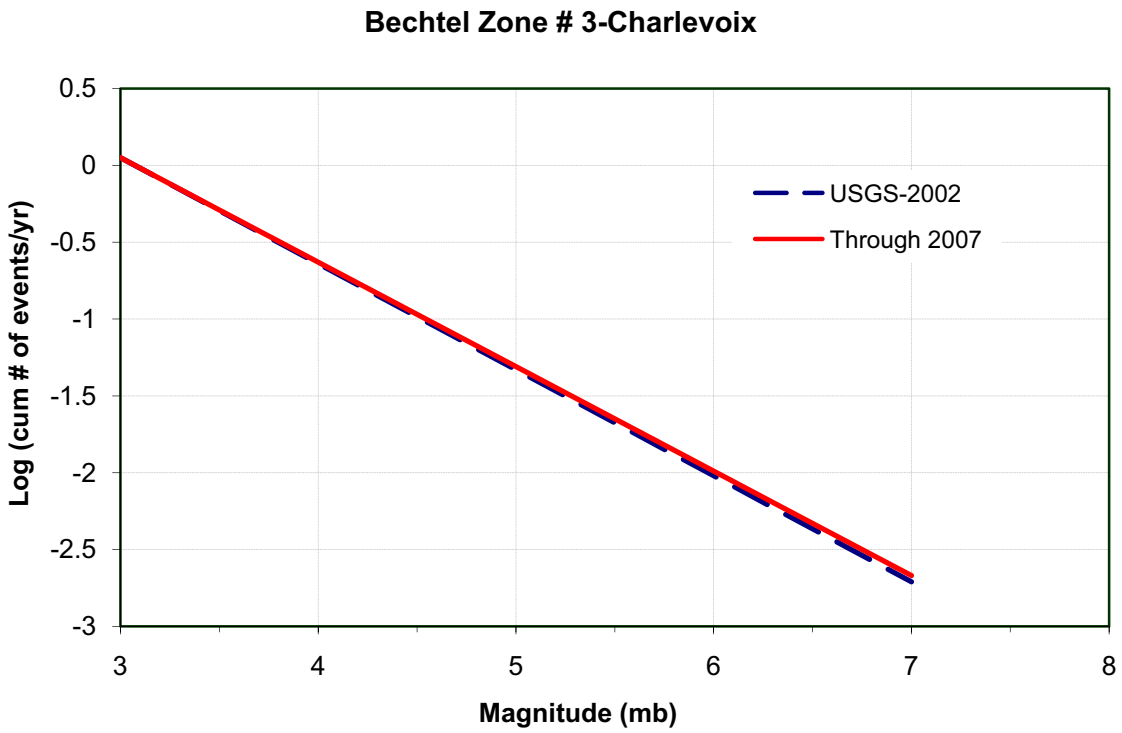
Figure 2.5-93 {Comparison of Seismicity Rates}



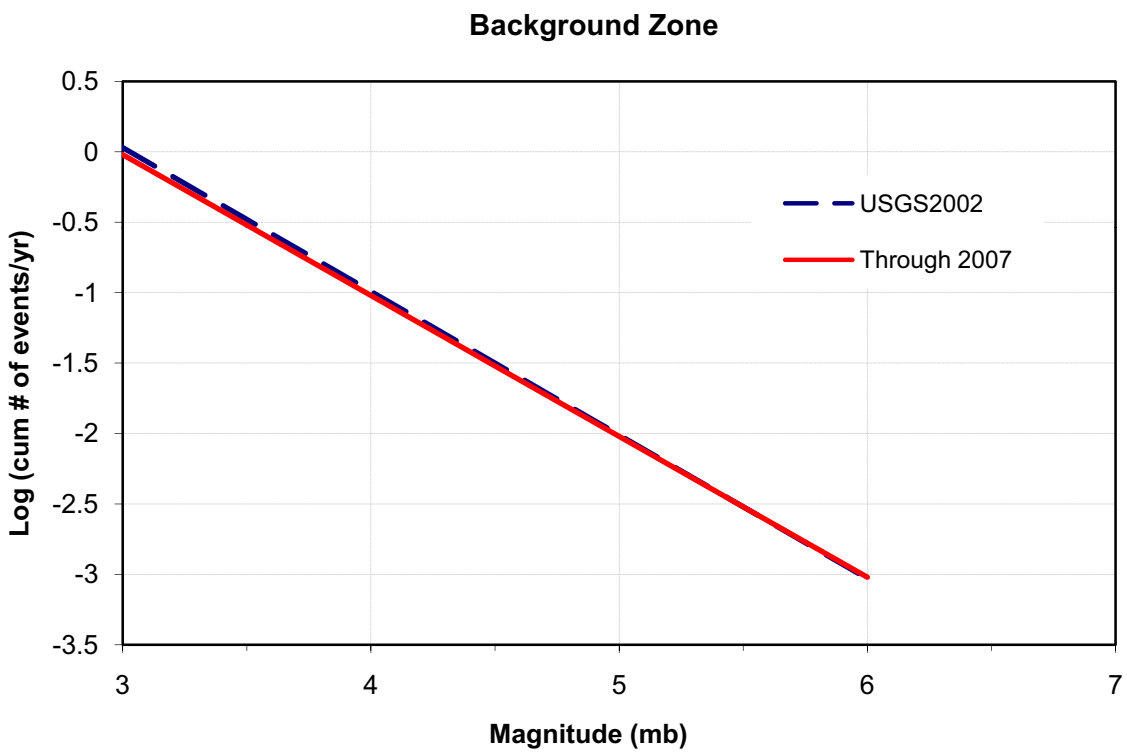


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Figure 2.5-94 {Comparison of PGA-Mean Hazard Curves}

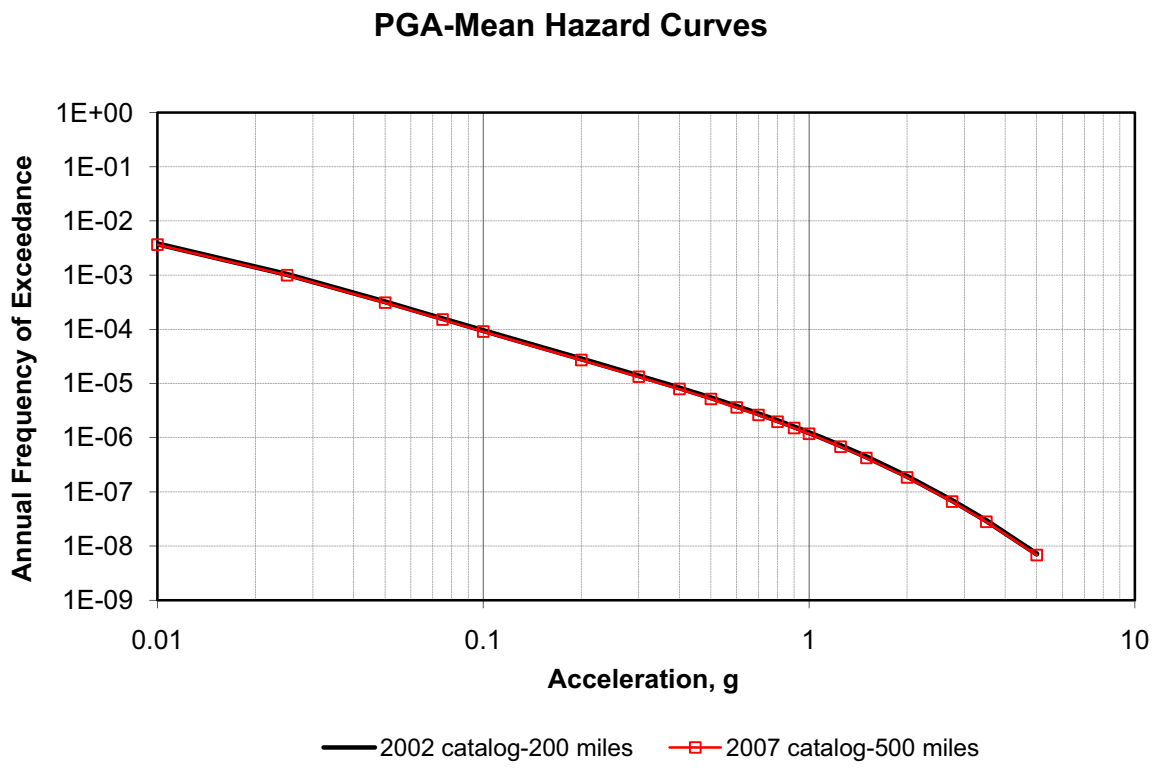

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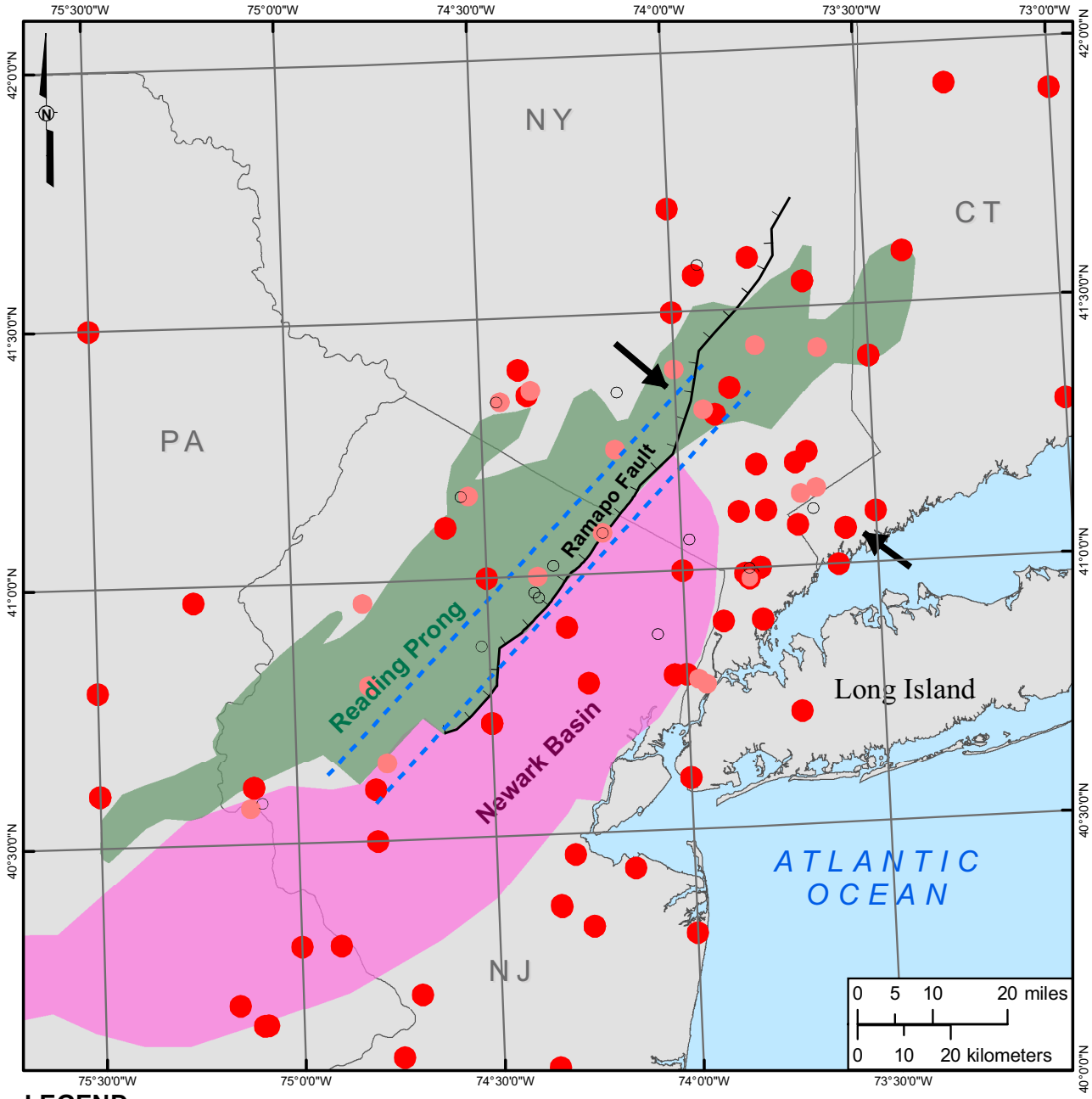
Figure 2.5-95 {Seismicity of New York-Philadelphia Area}



LEGEND

Earthquakes by Magnitude, mb

USGS 2007

- M < 2.25
- 2.25 < M < 3.0
- M >= 3.0

- Ramapo Fault
- Reading Prong
- Newark Basin
- RSZ

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- Sykes et al, 2008.

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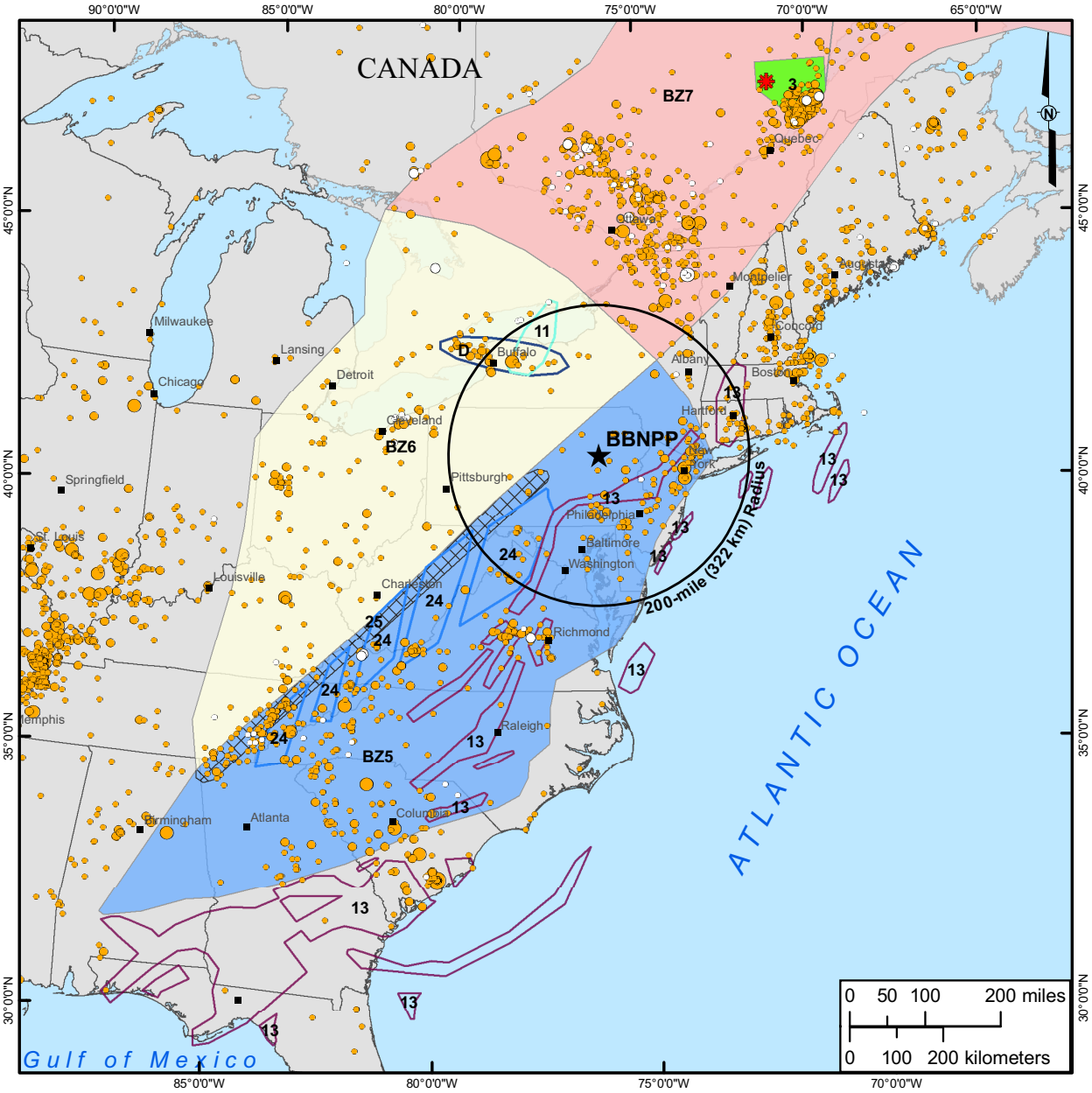
Figure 2.5-96 {Bechtel EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie/Charlevoix
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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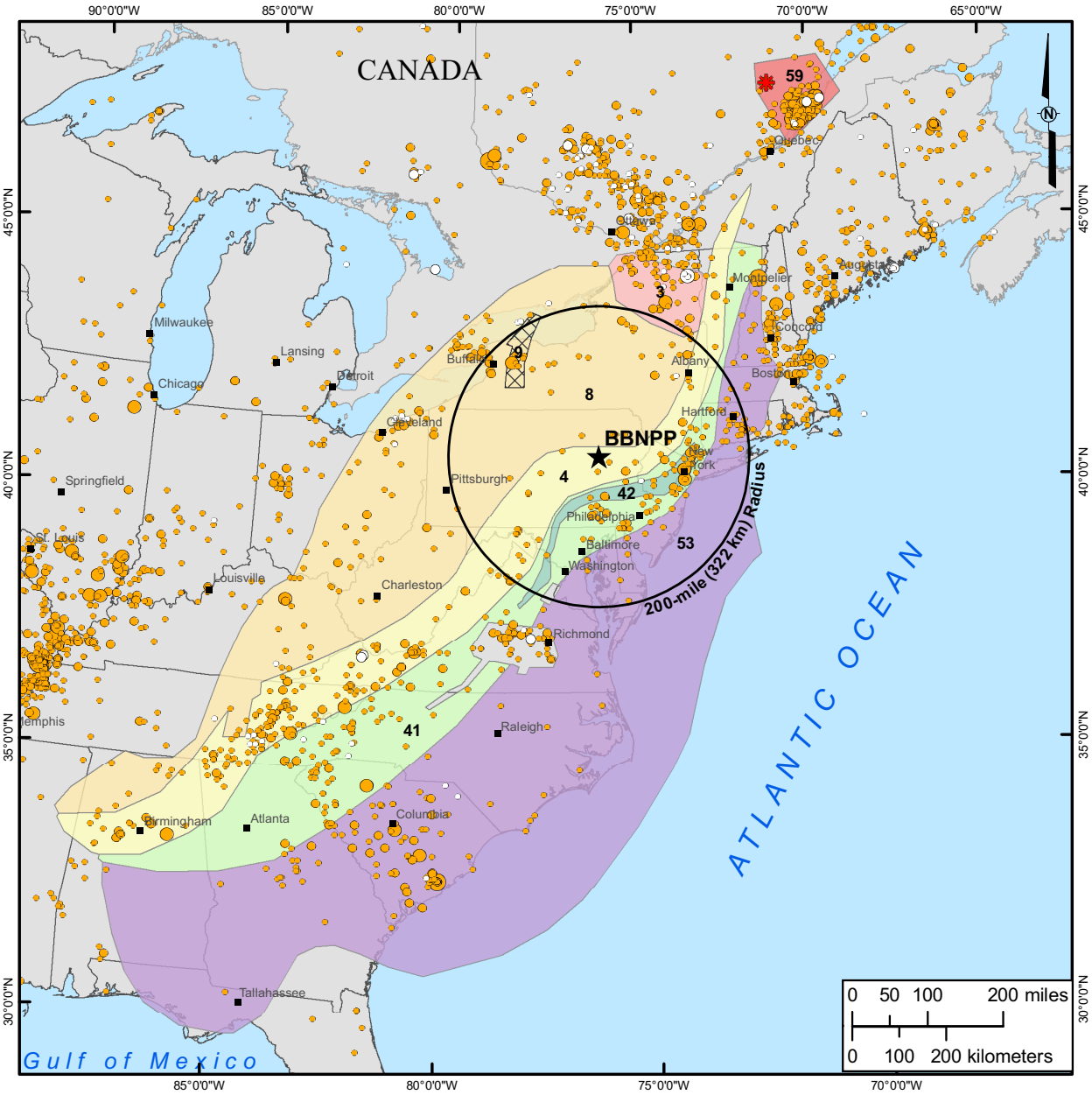
Figure 2.5-97 {Dames and Moore EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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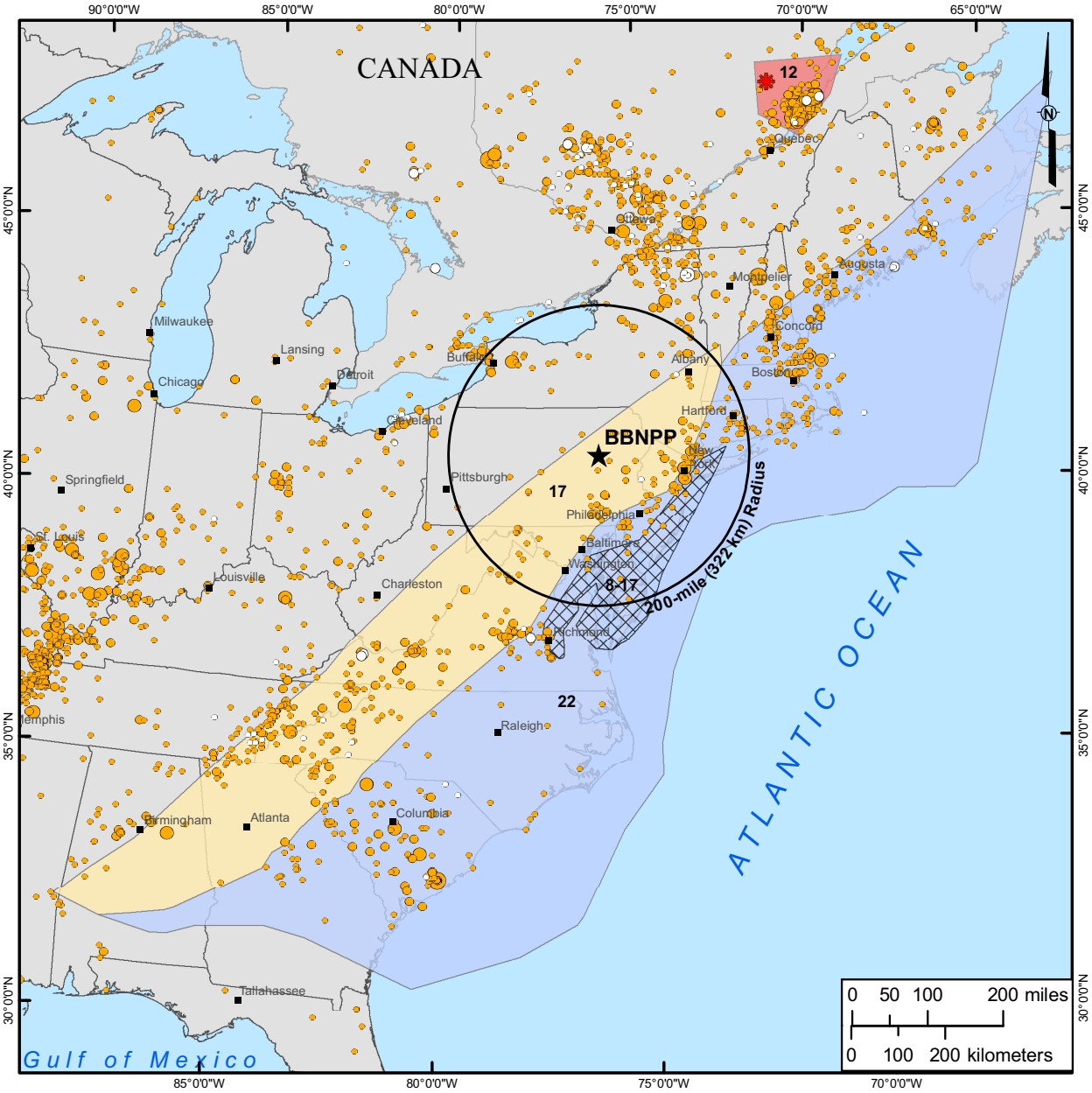
Figure 2.5-98 {Law Engineering EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

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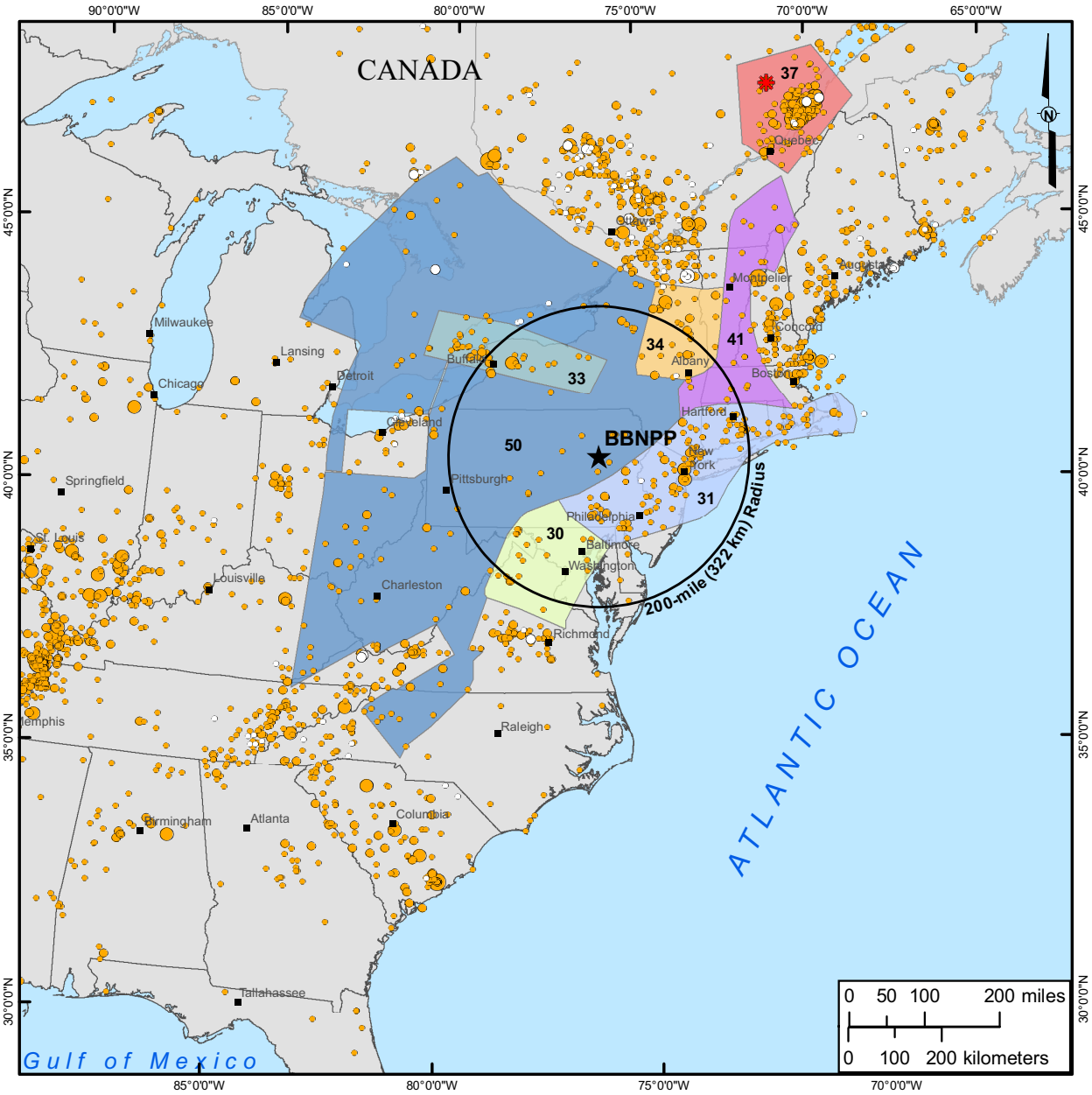
Figure 2.5-99 {Rondout Associates EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	✱ Saguenay Earthquake
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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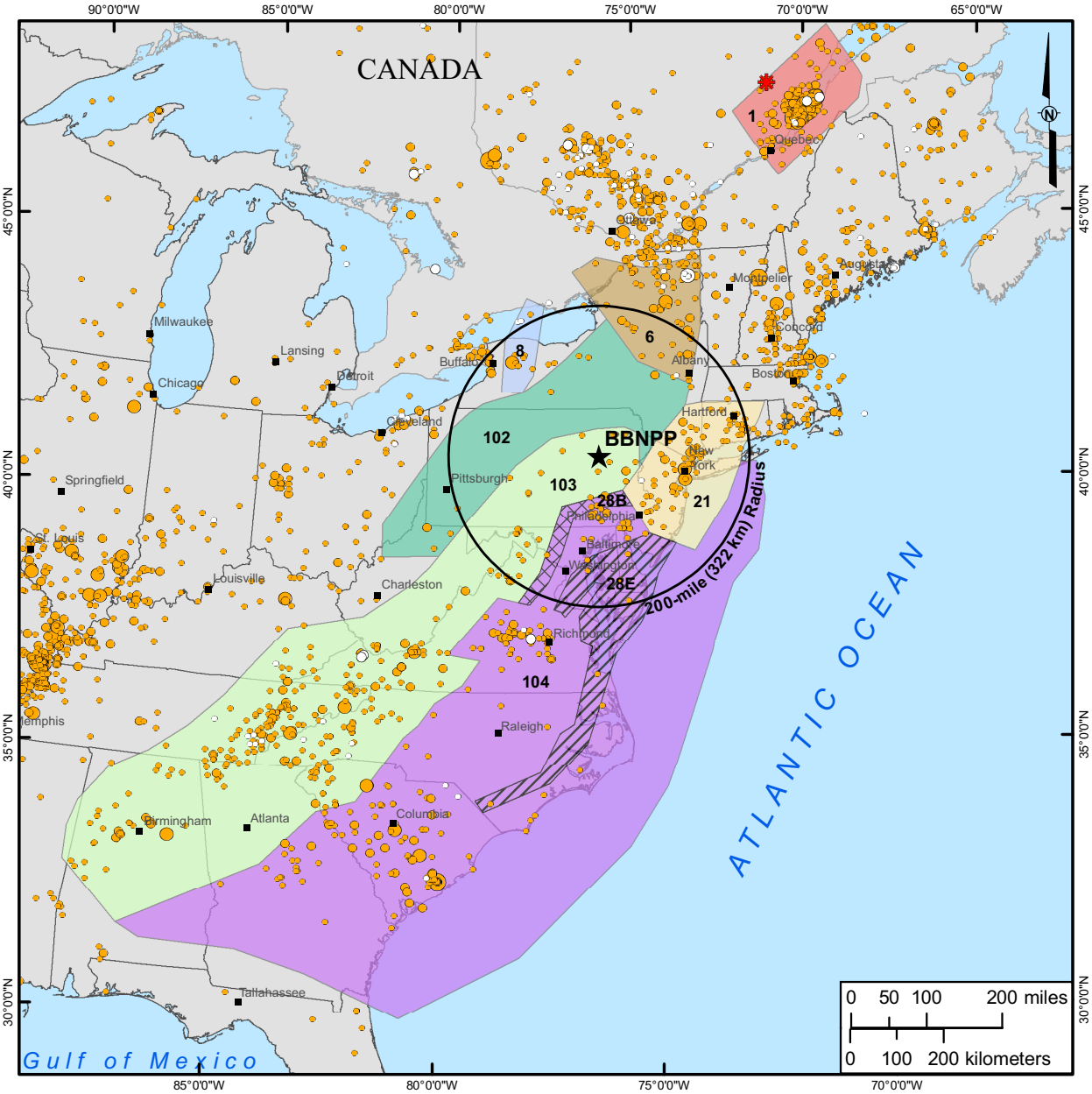
Figure 2.5-100 {Weston Geophysical EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 28B Zone of Mesozoic Basin
- 28E Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

✱ Saguenay Earthquake

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

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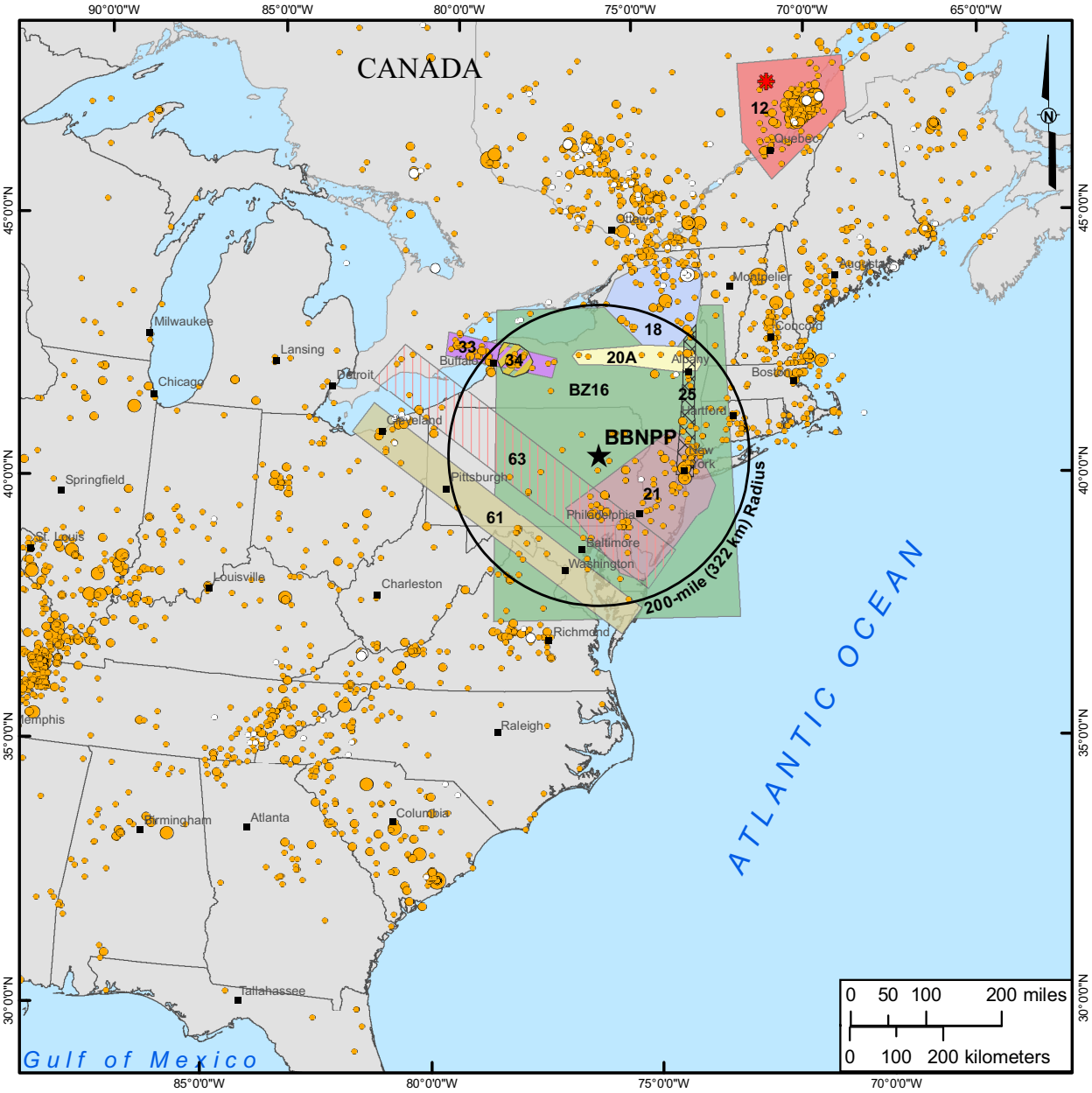
Figure 2.5-101 {Woodward-Clyde EPRI Source Zones for Charlevoix Sensitivity Analysis Case 1}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 25 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 63 Tyron-Mt. Union Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 61 Pittsburgh-Washington Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

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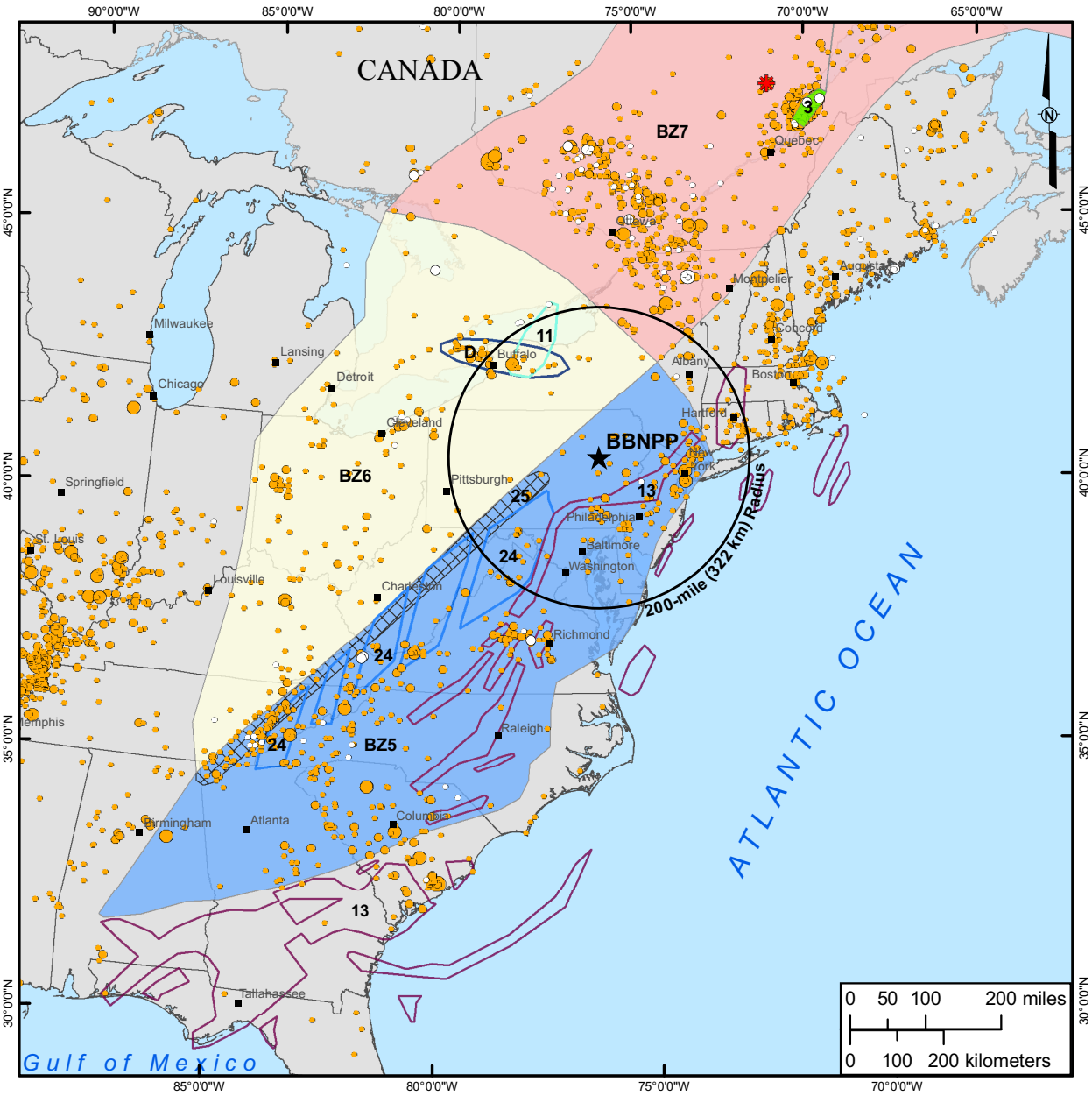
Figure 2.5-102 {Bechtel EPRI Source Zones for Charlevoix Sensitivity Analysis Case 2}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie/Charlevoix
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

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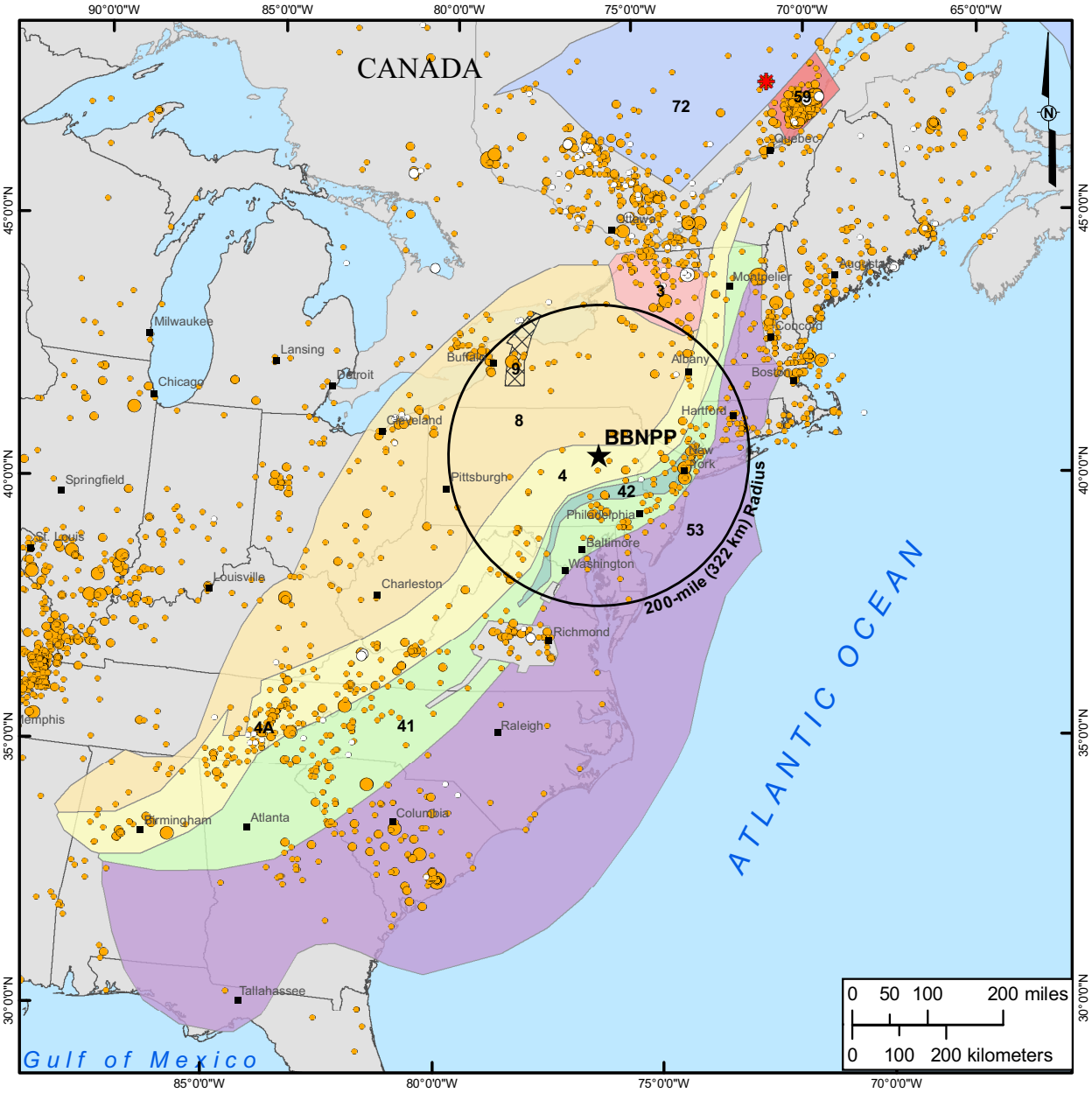
Figure 2.5-103 {Dames and Moore EPRI Source Zones for Charlevoix Sensitivity Analysis Case 2}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- 9 Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone
- 72 Zone 72

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

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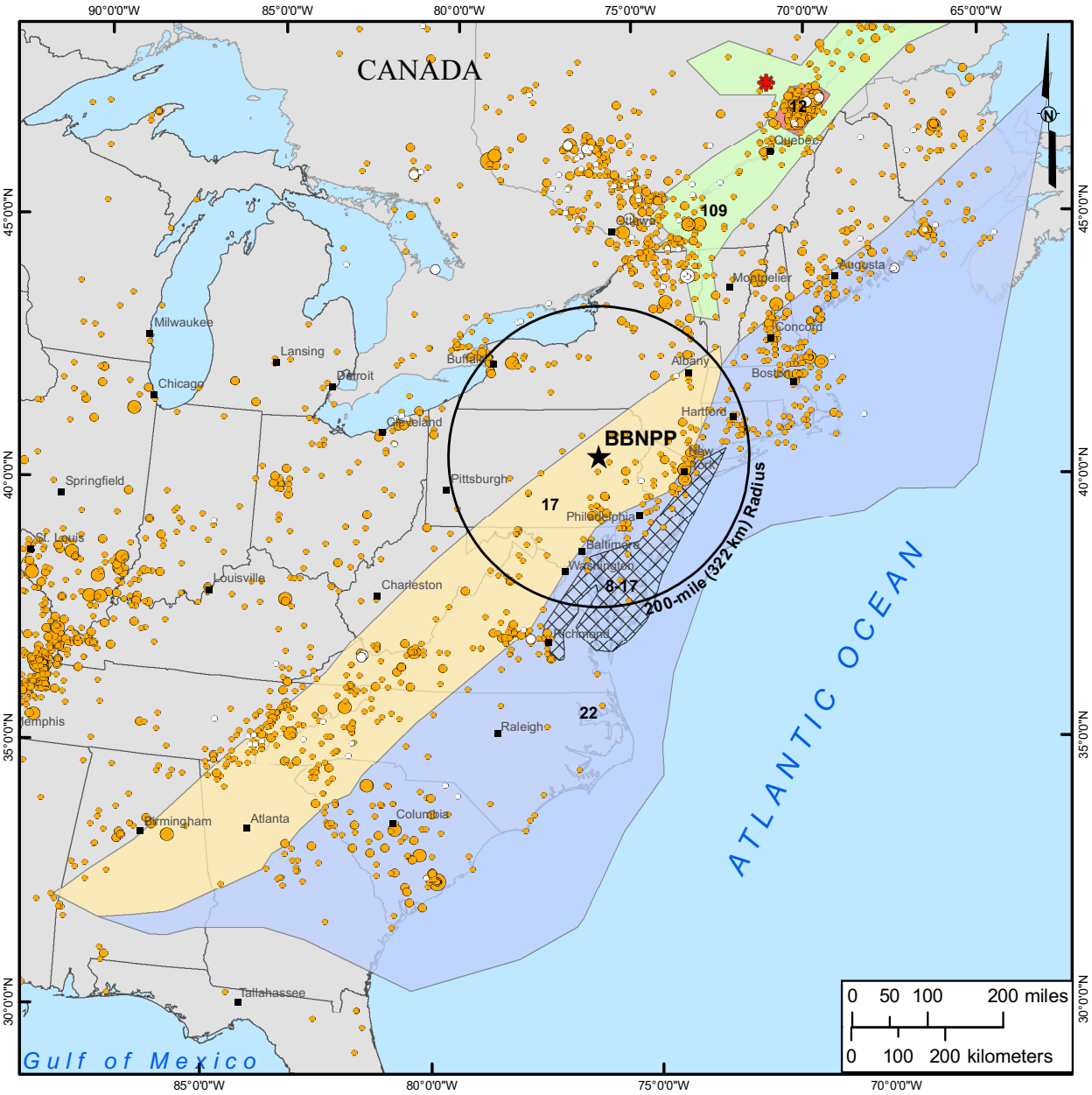
Figure 2.5-104 {Law Engineering EPRI Source Zones for Charlevoix Sensitivity Analysis Case 2}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 8-17 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone
- 109 Zone 109

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	
7.0 - 7.9	

✱ Saguenay Earthquake

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

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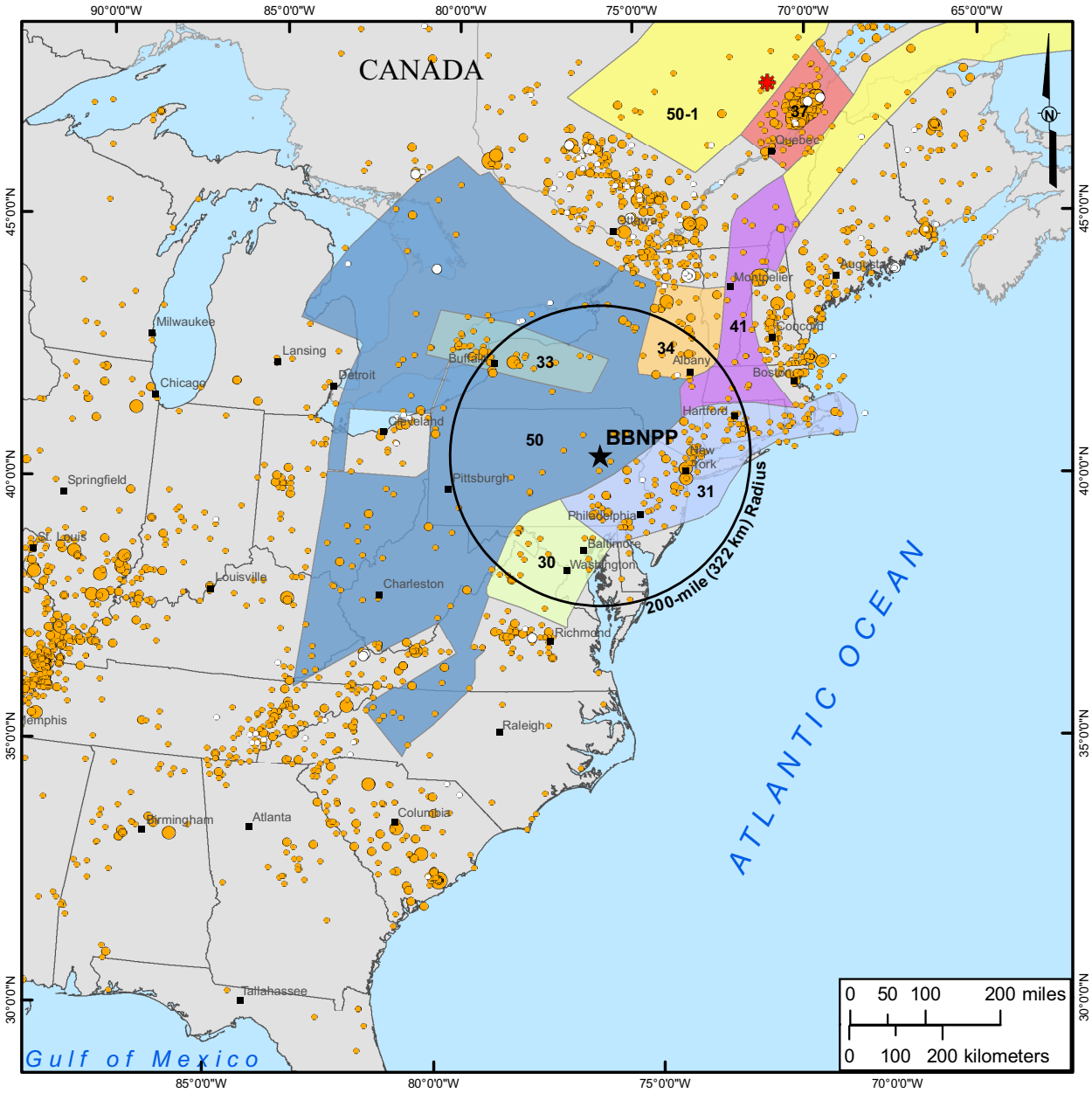
Figure 2.5-105 {Rondout Associates EPRI Source Zones for Charlevoix Sensitivity Analysis Case 2}



LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

■ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

USGS 2001	USGS 2002 to 2007
3.0 - 3.9	3.0 - 3.9
4.0 - 4.9	4.0 - 4.9
5.0 - 5.9	5.0 - 5.9
6.0 - 6.9	✱ Saguenay Earthquake
7.0 - 7.9	

NOTE: The 2002 to 2007 seismicity shown in 625-mile (1000 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)
- 50-1 Zone 50-1

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

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