

## **MEMORANDUM**

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**To:** Lora Werner, David Fowler, Debra Gable, and Ketna Mistry  
**cc:** Bob Driscoll, Debra Bolton, and David Cramer  
**From:** Laura Green  
**Subject:** Follow up information and data on sulfur dioxide, particulate matter, and heavy metals  
**Date:** August 15, 2007

Thank you again for our August 1, 2007 meeting in Alexandria VA. It was a pleasure to meet you, and to exchange ideas on several topics.

As I mentioned, there are various data sets that might be useful to you as you analyze and interpret the data from your ambient air sampling program. These data pertain to all three sets of pollutants included in your Exposure Investigation (EI). In particular, at your "Chemicals involved" website (<http://www.atsdr.cdc.gov/sites/mirant/chemicals.html>), you write:

ATSDR monitored for pollutants that are most likely to be emitted from the Mirant Plant and that are most likely to pose health concerns to the community. The pollutants monitored are sulfur dioxide (SO<sub>2</sub>), select metals, and particulate matter.

Allow me please, on behalf of Mirant, to share the following relevant information with you.

### **Sulfur dioxide**

As you have correctly noted, short-term (on the order of 5-minute) exposures to high concentrations of sulfur dioxide can cause respiratory problems for un-medicated exercising asthmatics (and, at very high concentrations, to anyone). As a result, since mid-April, 2007, Mirant has been collecting sulfur dioxide data at 5-minute intervals at its ambient air quality monitors very close to the plant. As you know, to date, none of the 5-minute sulfur dioxide samples from any of Mirant's six monitors targeted at the Potomac River Generating Station (PRGS) revealed concentrations as large as U.S. EPA's draft level of concern (600 – 1,000 parts per billion, ppb). Of the 193,483 valid measurements reported to date (from mid-April through August 9th), 93.6 % are smaller than 10 ppb, and 99.7 % are smaller than 100 ppb. Mirant plans to continue collecting these 5-minute data.

On the basis of extensive current data, then, sulfur dioxide concentrations in ambient air near the PRGS do not appear to pose a risk to public health.

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**Particulate matter (PM) — both total (TSP) and respirable (PM<sub>10</sub> and PM<sub>2.5</sub>)**

As you may know, the City of Alexandria<sup>1</sup> has expressed a concern that the Potomac River Generating Station's (PRGS's) use of trona (sodium sesquicarbonate) in its pollution control systems may increase stack emissions (and hence local ambient air concentrations) of particulate matter (PM), especially fine particulate matter (PM<sub>2.5</sub>). The City also noted some slight increases in average stack opacity readings during the summer of 2006 (when trona was in use) relative to the previous summer (when it was not). Based on these averages, the City hypothesizes, "given that . . . PM emissions tend to increase exponentially with opacity, and that Mirant PM testing data showed that ~80% of stack emissions was PM<sub>2.5</sub>, it is very likely that PM<sub>2.5</sub> emissions have increased with trona use."

As demonstrated below, in several respects, data from and near the PRGS do not support these hypotheses.

*Prima facie*, one might well expect that "more PM in = more PM out." As it happens, this is not the case for PRGS. This is because the PRGS units are equipped with two electrostatic precipitators (ESPs), in series — a "hot side" ESP, followed by a "cold side" ESP, prior to atmospheric release. (I know of no other power plants that have this feature). As shown below, these serial ESPs result in quite effective PM control, such that PM stack emissions in the presence of trona are no greater than, and sometimes less than, PM emissions when trona is not in use.

Moreover, under all circumstances, PM emissions from the PRGS are substantially less than the permit limit of 0.12 lb PM/MMBtu.

The relevant details are as follows.

In December 2006, PRGS unit 3 was tested when it was operating both without and with trona. Testing was for, among other things, filterable PM<sub>2.5</sub>, PM<sub>10</sub>, and total PM (that is, TSP; Conditional Method 040).<sup>2</sup>

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<sup>1</sup> Via its letter of May 22, 2007, from John B. Britton (Counsel for the City of Alexandria) and Ignacio B. Pessoa (City Attorney, City of Alexandria) to Monica Harvey, VDEQ, "Re: Comments on Draft Permits," Attachment 2, page 2.

<sup>2</sup> The main body of the December 2006 Stack Test Report does not mention total PM measurements, but Appendix D to this Report provides test data on PM larger than 10 µm in diameter. These PM measurements essentially represent TSP.

PM concentrations were tested at three points:

1. The *inlet* to the first (hot-side) ESP;
2. The *outlet* from this first ESP (which also represents loading to the inlet to the second ESP); and
3. The *outlet* from the *second* (cold-side) ESP (which also represents emissions from the stack to the atmosphere).

As shown in Figure 1, and as one would expect, the particle loading entering the first ESP was substantial: on the order of 6 lb/MMBtu without trona, and 12 lb/MMBtu with trona.

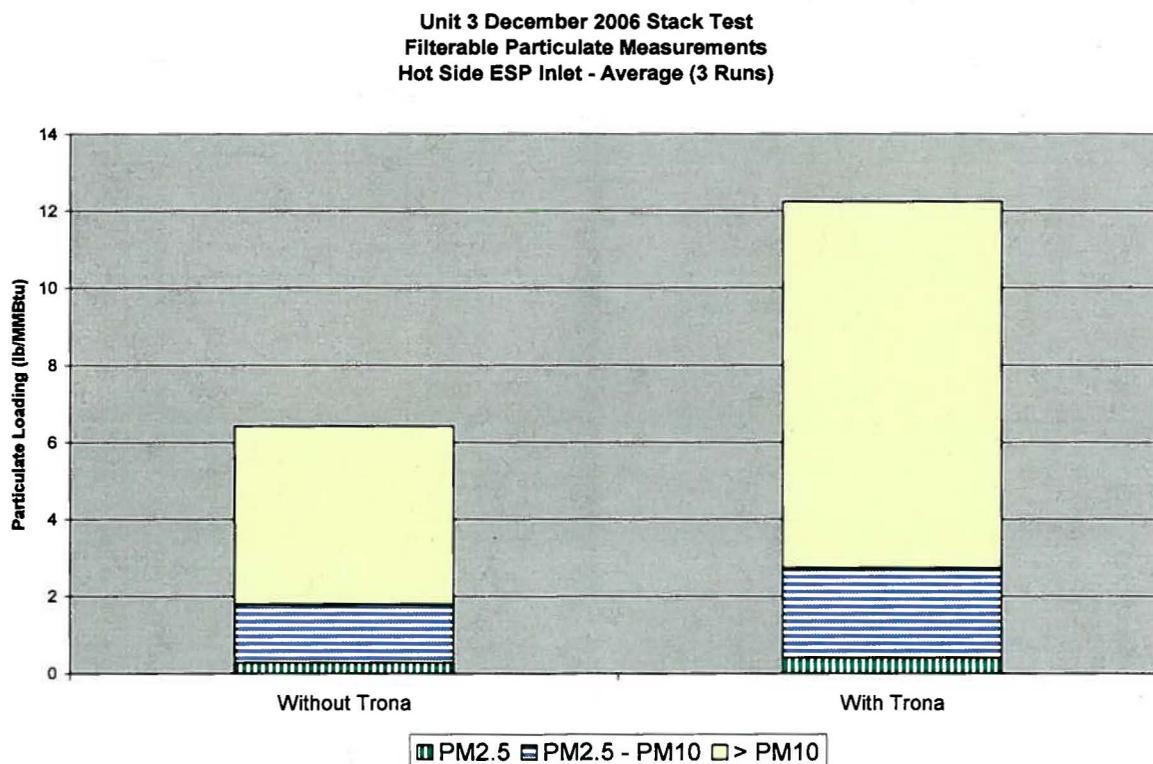


Figure 1

Figure 2 shows that the first ESP reduces this loading substantially, removing about 97% of the particles in both cases (so that about 0.15 and 0.3 lb/MMBtu entered the second ESP in the absence and in the presence of trona, respectively).

Unit 3 December 2006 Stack Test  
Filterable Particulate Measurements  
Cold Side ESP Inlet - Average (3 Runs)

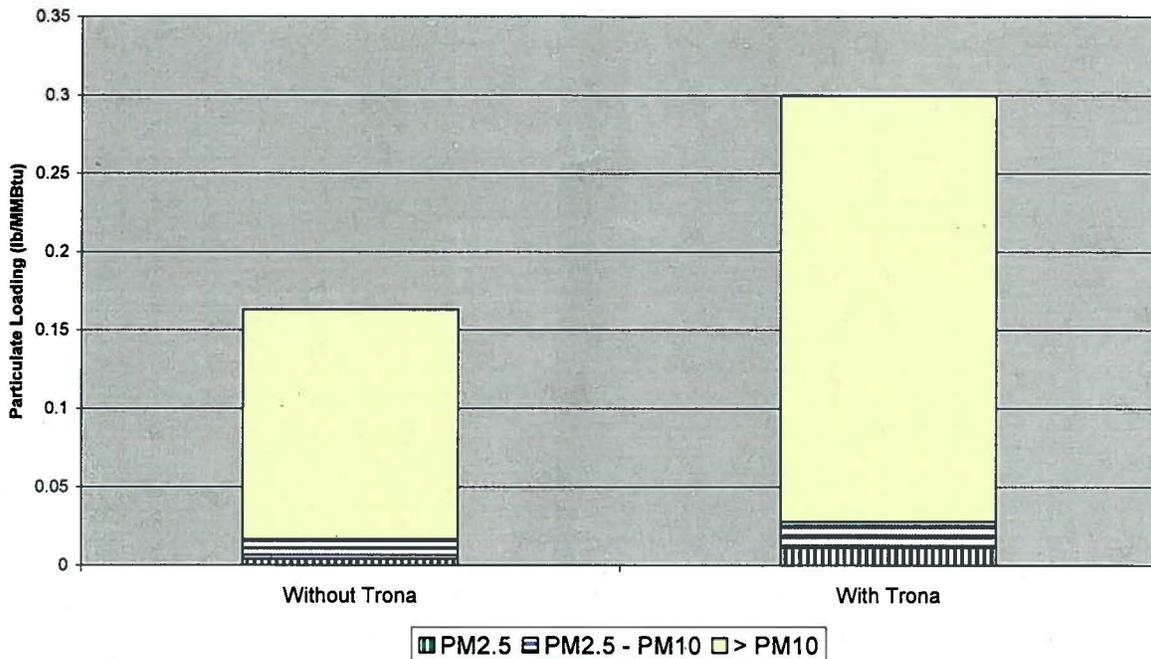


Figure 2

Interestingly, Figure 3 shows that the second ESP removes relatively more of the particles when trona is used than when it is not: the result is that PM emissions totaled only 0.007 lb/MMBtu regardless of the presence or absence of trona.

Please also note that, contrary to the City's hypothesis, non-respirable (that is, larger than 10 micron) particles dominate (in both cases), and that PM<sub>2.5</sub> emissions are quite small (less than 0.001 lb/MMBtu).

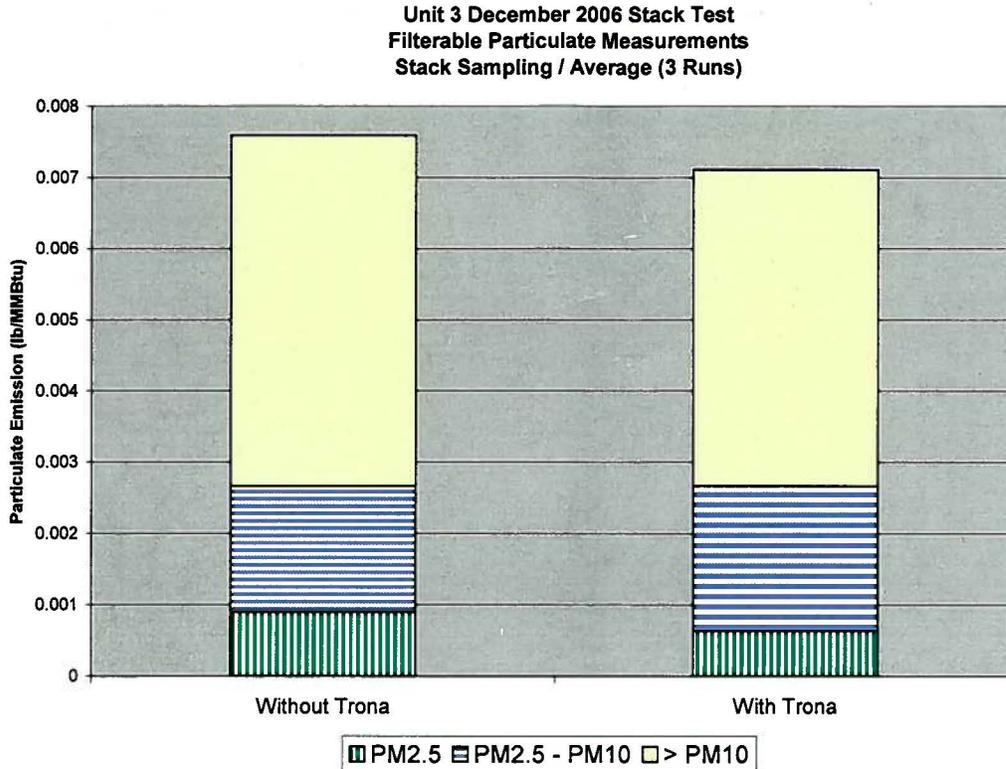


Figure 3

The following table summarizes the collection efficiencies of each ESP, and of the ESPs in series. The increased efficiency of the cold-side ESP in the presence of trona is notable.

**Particulate Matter (PM) Collection Efficiencies Measured in Unit 3 Testing (December 2006)**

PM Fraction	Stack tests <i>without</i> Trona			Stack tests <i>with</i> Trona		
	Hot-side ESP	Cold-side ESP	Combined ESPs (Overall)	Hot-side ESP	Cold-side ESP	Combined ESPs (Overall)
PM <sub>2.5</sub>	98.8%	74.9%	99.7%	97.6%	94.2%	99.9%
PM <sub>10</sub>	99.0%	71.2%	99.9%	99.0%	88.8%	99.9%
TSP	97.4%	71.6%	99.9%	97.7%	96.0%	99.9%

Testing of PM<sub>10</sub> emissions undertaken a year earlier (December 2005), on unit 1, also showed that use of trona did not increase PM<sub>10</sub> stack emissions, and even significantly reduced such emissions, relative to the “no trona” case.

I have also examined whether opacity readings, in the typical range of 3% to 7%, correlate with PM emissions. As shown in Figure 4, they do not.

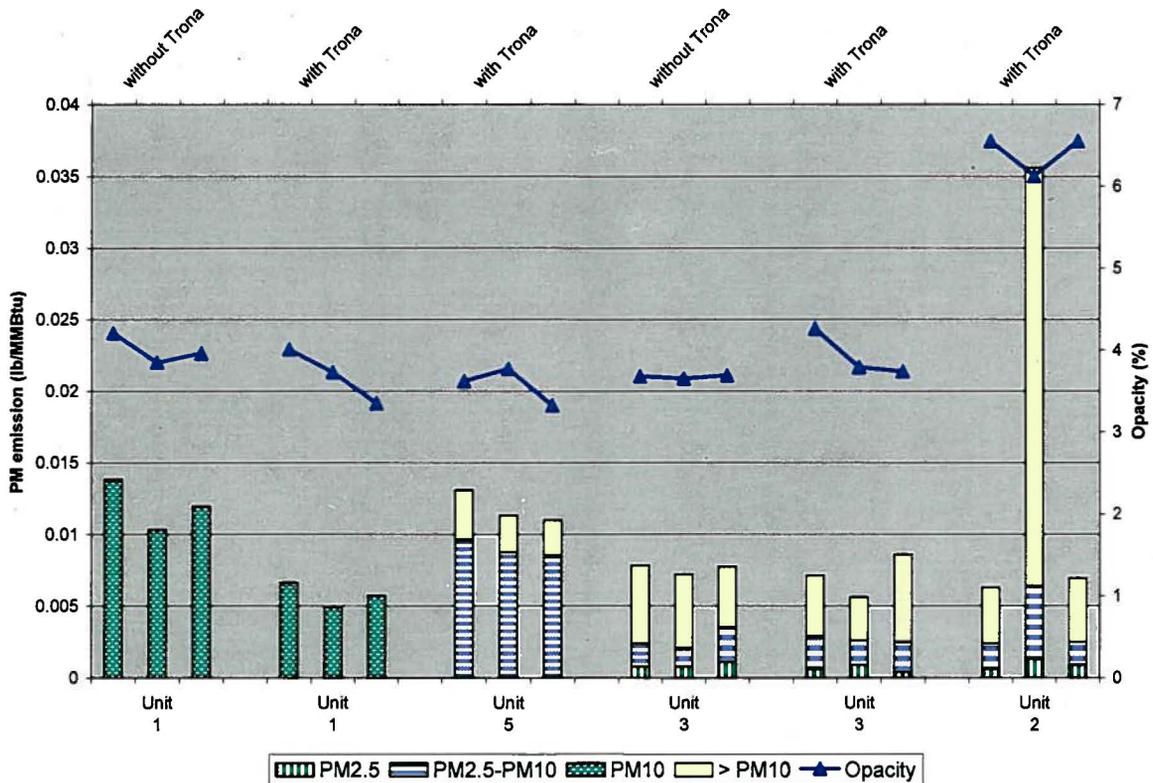


Figure 4

As depicted in Figure 4, total PM emissions (that is, both larger and smaller than 10 microns in mass mean aerodynamic diameter) were monitored during four of these sets of tests: for the two sets of tests performed on unit 1, only PM<sub>10</sub> data are available. Regardless, whether one focuses on total PM or respirable PM, variations in opacity do not predict variations in PM emissions.

Of course, in the extreme, very low (or very high) opacity readings correlate with very small (or very large) concentrations of PM, but variations between 3% and 7%, at least in this setting, do not. More generally, opacity depends on several factors other than total PM mass concentrations, including particle size distributions and specific qualities of particles that affect light scattering/reflection (see, for example, EPA, 2000, *Current Knowledge of Particulate Matter (PM) Continuous Emission Monitoring*. Available at: <http://www.epa.gov/ttn/emc/cem/pmcemsknowfinalrep.pdf>).

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Finally, Mirant's ambient air PM<sub>2.5</sub> monitors, targeted at "worst-case points" near the PRGS, have shown 24-hour average concentrations of only 13 µg/m<sup>3</sup>. In only one instance has *any* PRGS PM<sub>2.5</sub> monitor registered a 24-hour average value larger than the new NAAQS of 35 µg/m<sup>3</sup> (this was a 24-hr. value on May 26, 2007, which was 36.2 µg/m<sup>3</sup>), but this concentration was recorded when southerly winds were blowing *from* the monitor *to* the facility, so were not reflective of contributions from the PRGS.

Overall, then, stack test data, opacity data, and ambient air monitoring data indicate that the City's concerns with regard to the PRGS and particulate matter emissions and/or impacts are unsupported.

#### **Metals on PM**

As we discussed, and as you know, all samples of TSP taken anywhere in the world will show detectable concentrations of most of the metals you are seeking in your study. This is because TSP metals derive from natural crustal sources, from re-suspended dust from roads, fields, and other "area" sources, and from emissions from mobile and stationary point sources.

Importantly, stack-test and fly ash-test data from the PRGS indicate that none of the metals sought in your Exposure Investigation are emitted to ambient air at toxicologically significant rates.

The relevant details are these.

As you know, samples of PRGS fly ash — generated both with and without the use of trona — have been analyzed for heavy metals and other inorganic constituents. Only trace concentrations of many metals were found, and, as expected, mercury was not detected in any samples, regardless of trona use (<http://www.eh.doe.gov/nepa/seas/sea-04.pdf>). Given the very low emission rates of total PM from the PRGS (as described above), and given the tiny proportions of emitted PM that are heavy metals (as opposed to sulfates, nitrates, organic aerosols, silica, and alumina), the hypothesis that PRGS's emissions *per se* could lead to toxicologically significant concentrations of these metals in ambient air is unsupported.

Moreover, as we also discussed, since your metals data will be from TSP, not from respirable PM, it will be important (i) to compare your results to TSP-metals data from control sites, and (ii) to refrain from interpreting the data by means of comparisons to "cancer reference" concentrations, since the latter apply to respirable PM, not to TSP (and since metal contents of the latter cannot be used to extrapolate to metal contents of the former).

To assist you with your comparisons, we have compiled data on TSP-metals concentrations in other areas of the U.S. (restricted to East of the Mississippi River, since soil compositions differ in the West). The results are as follows, and our spreadsheet is attached for your use.

<b>Metals that ATSDR seeks in ambient air <i>via</i> its EI near the PRGS</b>	
<b>Metal</b>	<b>Range of 2006 annual average concentrations at Eastern/mid-Western sites <sup>(A)</sup></b>
Antimony	0.001 – 0.003 $\mu\text{g}/\text{m}^3$
Arsenic	<b>0.00054 – 0.006</b> $\mu\text{g}/\text{m}^3$
Beryllium	0.000031 – 0.00041 $\mu\text{g}/\text{m}^3$
Cadmium	<b>0.0001 – 0.0028</b> $\mu\text{g}/\text{m}^3$
Chromium, total	<b>0.001 – 0.016</b> $\mu\text{g}/\text{m}^3$ <sup>(B)</sup>
Cobalt	0.00015 – 0.0010 $\mu\text{g}/\text{m}^3$
Lead	0.002 – 0.756 $\mu\text{g}/\text{m}^3$
Manganese	0.004 – 2.2 $\mu\text{g}/\text{m}^3$
Mercury	— <sup>(C)</sup>
Nickel	0.0007 – 0.067 $\mu\text{g}/\text{m}^3$
Selenium	— <sup>(D)</sup>

- <sup>A</sup> Minimum and maximum of annual average atmospheric mass concentrations measured in TSP samples collected at U.S. EPA monitoring sites in states east of the Mississippi River. Data include results from monitors with at least 50% of concentrations measured above the detection limit, and with non-zero reported annual averages. Data downloaded from the U.S. EPA AirData Annual Summary Table Query webpage: [http://www.epa.gov/aqspubl1/annual\\_summary.html](http://www.epa.gov/aqspubl1/annual_summary.html).
- <sup>B</sup> Measured concentrations are for total chromium, not hexavalent chromium. Per SCAQMD (2000), only some 2% of total chromium in ambient air PM is in the form of CrVI.
- <sup>C</sup> Only 10 TSP mercury concentrations above the detection limit were measured in 116 samples at 10 monitoring locations. No monitoring locations had greater than 50% of concentrations measured above the detection limit.
- <sup>D</sup> No non-zero annual average values for TSP selenium were reported in 2006 for monitors east of the Mississippi River.

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Based on the ubiquity of many of these metals, especially of arsenic (As), cadmium (Cd), and chromium (Cr), you can expect to find concentrations of two or three of these metals that, at first glance, might appear to exceed "levels of concern," based on theoretical cancer risk estimates. Of course, as noted above, since you are not collecting respirable metals data, no such theoretical cancer risk estimates would be appropriate. Also, as noted above, the emissions data and fly ash data show that PRGS is not a significant atmospheric source of these metals in either respirable or non-respirable particulate emissions. To the extent that your "Chemicals involved" website (<http://www.atsdr.cdc.gov/sites/mirant/chemicals.html>) suggests otherwise, it is not accurate.

Moreover, only a tiny fraction of the Cr that you will detect will be present as Cr VI (the only form known to cause cancer, given sufficiently high exposures). As you know, Cr is present in very small concentrations (typically nanograms per cubic meter,  $\text{ng/m}^3$ ) in ambient air due to both natural and anthropogenic sources. Airborne crustal dust contains Cr primarily from Cr III-based ores (NAS, 1974; Lantzy and MacKenzie, 1979). Data reported by the South Coast Air Quality Management District (SCAQMD) indicate that hexavalent chromium constitutes a small fraction of the total chromium in ambient air, even near cooling towers that use chromates as anti-scaling agents, let alone elsewhere. According to ambient air samples from a major air quality study focused on hazardous air pollutants (SCAQMD, 2000), hexavalent chromium makes up only 1.0-3.3% of the total chromium in ambient air, even at expected Cr VI "hot spots," with an average of 2% and an absolute concentration of  $0.2 \text{ ng/m}^3$  of Cr VI.



I hope that this information is useful to you as you move forward with your study and reports. Please call or write with questions or concerns, or if I can further assist.

Thank you, and best regards.

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## References

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