**Calculation 98-ENG-02405D2, Revision 2**

**Attachment 6**

Process Conditions Under Which the Service Water Inlet Source Temperature is Homogeneous

The following information is provided by Robert L McGuinness via e-mail, the elements pertinent to this calculation are underlined:

*Bob,*
*Mike Fiala informed me you could use some input for determining if it is acceptable to average the Intake / UHS temperature instruments at Unit 2.*

1) *As we know, the Tech Spec Bases 3/4.7.11 describes that we shall use the highest reading valid temperature obtained from the Unit 2 intake structure (2 instruments) and the inlets to the Circulating Water System waterboxes (4 instruments) to verify the UHS temperature is ≤ 70-degF.*
2) *The Tech Spec Bases also describe that if temperature is above 70-degF, that monitoring is performed at the Vital AC Switchgear Service Water heat exchanger inlets; or at the RB heat exchanger inlets if the temperature cannot be taken at the Vital AC switchgear heat exchanger inlets.*

*Temperature averaging may help determine a more accurate temperature in all four cases (Intake, Waterboxes, Vital AC, and RB inlets). I understand that temperature instrument averaging may help reduce an unnecessarily high reading, on average, up to approximately ½-degree. Of course, an Engineering basis would be needed to proceed with averaging. In all cases, the individual temperatures can deviate from normal due to temporary thermal transients caused by main condenser waterbox backflushes and by thermal mussel cooks performed in individual bays. The temporary transients affect individual temperature instruments immediately at the beginning of the flush or cook, then exponentially return to normal within an hour.*

*Regards,*
*Bob -6855*

Temperature data was obtained from the MPS2 Plant Process Computer (PPC) during both a thermal backwash (Figure A-1) and a mussel cook (Figure A-2) evolution. The temperature measurements recorded are the PPC inputs the "C" bay water quality monitor (T6690) and the four circulating water temperatures at the inlet of the condenser water boxes (T6557, T6564, T6596, and T6589). The assumption is that the circulating water temperature is representative of the inlet bay temperature in each of the four intake structure bays when the respective circulating water pump is in operation.

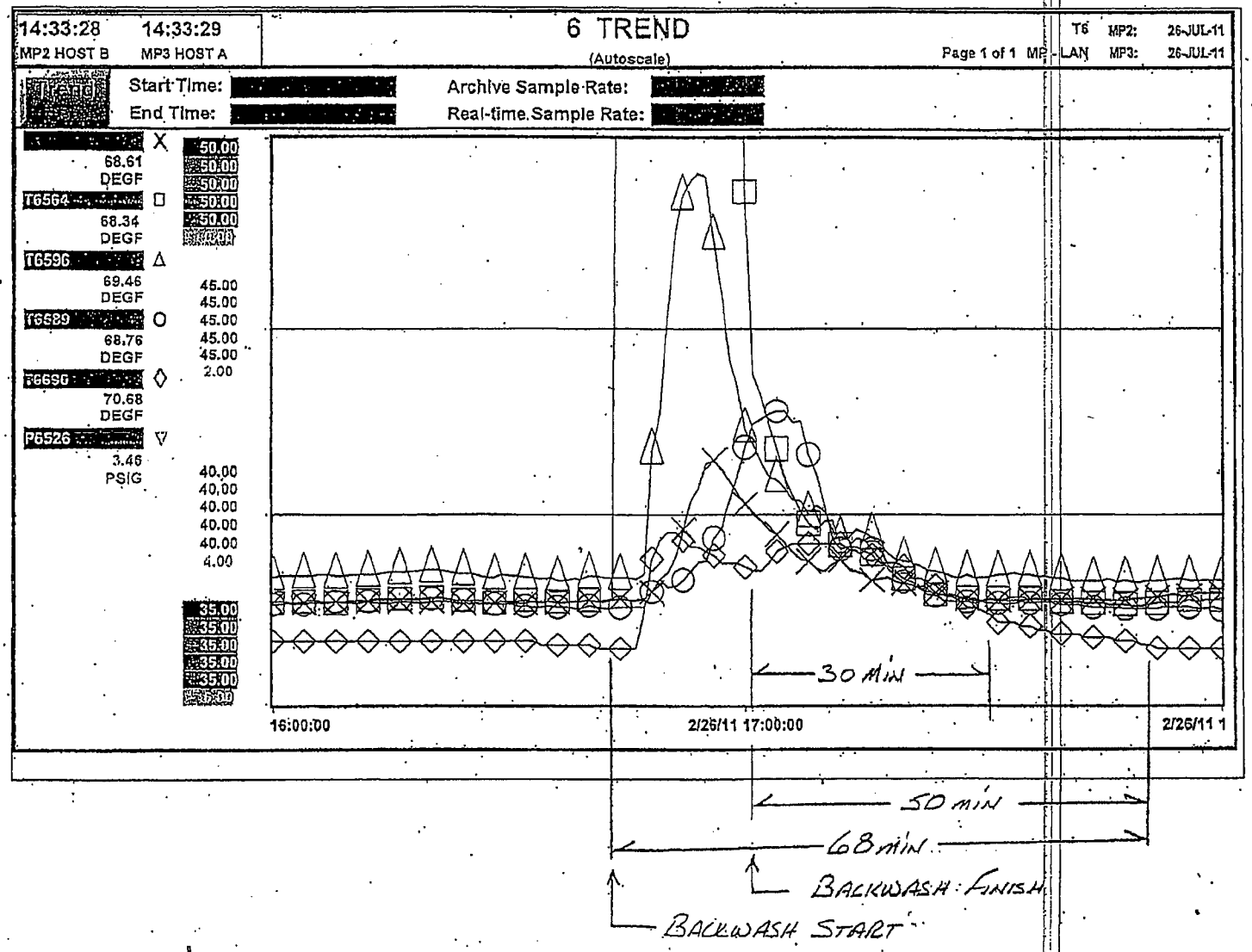


Figure A-1

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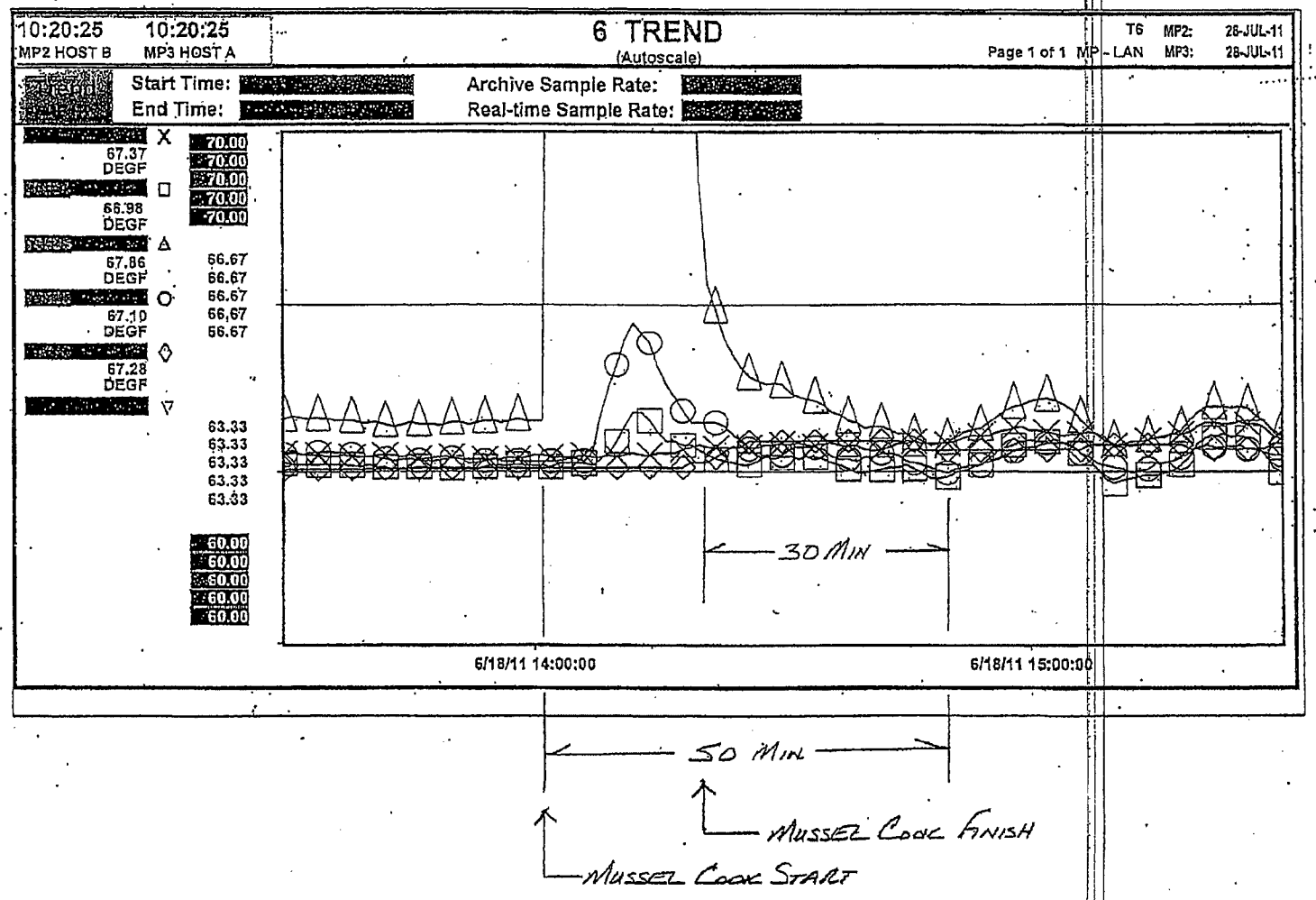


50 MIN

MUSSEL COOK FINISH

MUSSEL COOK START

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Figure A-2

Figure A-1 shows the temperatures resulting from a thermal backwash evolution. Upon commencement of thermal backwash the temperature in the associated circulating water pipe immediately increases reflecting the introduction of condenser heated water into the line. The backwash has been completed and normal operation commenced when the temperature in the associated circulating water pipe decreases reflecting the return of the colder seawater back into the line. This is followed by a period of normalization where the intake bays recover from the introduction of condenser heated fluid from the backwash evolution. In Figure A-1 it appears that temperatures in the circulating water lines have returned to their pre-backwash condition and are stable after approximately 30 minutes. In the figure, the temperature measured by the water quality monitor in bay "C" continues to decay and is also stable after approximately 50 minutes.

Figure A-2 shows the temperatures resulting from a mussel cook evolution. Upon commencement of mussel cook the temperature in the associated circulating water pipe immediately increases reflecting the introduction of condenser heated water into the line. The mussel cook has been completed and normal operation commenced when the temperature in the associated circulating water pipe decreases reflecting the return of the colder seawater back into the line. This again is followed by a period of normalization where the intake bays recover from the introduction of condenser heated fluid from the mussel cook evolution. In Figure A-2 it appears that temperatures in the circulating water lines have returned to their pre-mussel cook condition after approximately 30 minutes. In the figure, there appear to be some continued oscillations in the temperature measurements after the 30 minute period however the temperatures are all oscillating together suggesting a condition affecting all bays equally. In this evolution there does not appear to be as pronounced an impact on the temperature measured by the water quality monitor in bay "C" as there was in the thermal backwash evolution.

In the above two evolutions it appears that the intake structure bays have returned to a homogeneous condition after 30 minutes of normal operation following completion of each evolution. It is unknown why the response of the water quality monitor appears to lag behind the circulating water line temperature recovery. This might be a response time issue associated with the equipment, or some other dynamic not clear from the data presented. However, the circulating water pipe temperature data does show a clear recovery within 30 minutes. To provide

margin, a recovery period of 45 minutes before taking a Technical Specification UHS reading using the average of TI-6928, TI-6929, and TI-6930 will be specified.

The above information supports the following limitation on when temperature indicators TI-6928, TI-6929, and TI-6930 may be averaged to improve their temperature measurement accuracy, and the average temperature measurement used for the purposes of compliance with MPS2 Technical Specification 3/4.7.11:

> *"Temperature averaging of TI-6928, TI-6929, and TI-6930 may be utilized whenever the intake structure bays are at a homogeneous temperature that will ensure essentially equal inlet temperature conditions in both service water trains. This is expected to occur under all plant operating conditions, <u>except</u> when main condenser waterbox backflushes and thermal mussel cooks are being performed in any intake bay. Following the completion of either of these evolutions a minimum 45 minute period of normal system line up and operation will return the intake bays to a homogeneous temperature condition that will support averaging of the above temperature measurements."*