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To: Randy Amundson

From: James Masterlark

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Subject: Risk Ranking of Human Actions from the PBNP PRA

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The purpose of this memo is to transmit a risk ranking of human actions from the latest PRA update (Version 3.03). I am including 2 tables that rank the Human Actions from two perspectives: Fussell-Vesely (F-V) importance and risk achievement worth (RAW). Which of these rankings to use depends on the application.

F-V importance of a human action is the fraction or percent contribution to the total core damage frequency (CDF) attributable to the human action being performed incorrectly. It can also be looked upon as a measure of the maximum reduction in total CDF achievable based on the complete reduction in error probability of a human action, (i.e., error probability approaches 0). Therefore, F-V importance is a good measure to use when :iding which operator actions should have high quality procedures and enhanced (not necessarily more) .ining. The underlying assumption is that effective training and simplified procedures can reduce the error rate of the human action. Increasing the reliability of a human action with a low F-V importance will not result in a significant reduction in core damage risk. Therefore, it is not generally in the best interest of the plant to develop and implement enhanced training or procedures for a human action with a low F-V importance. Table 1 lists the top 15 human actions in order of highest to lowest F-V importance.

RAW is a measure of the increase in total CDF assuming the human action is never performed correctly (i.e., error probability is 1). This measure is not truly risk informed as it only relates to the consequences of the error without regard for the likelihood of occurrence (in reality it is a hybrid deterministic/probabilistic measure combining an assumed error, and the probabilistic result of the error). For example, a simple action to start a turbine driven pump from the Control Room will have a higher RAW than the pump due to the lower failure probability of the human action even though the consequence of the failures is the same (i.e., the pump doesn't work). This would lead one to believe that the action to start the pump is more important than the pump itself, and more resources should be spent training on the human action when in reality, the weak link is the pump. Human actions with a high error probability but a low RAW will have little or no impact on CDF if the error probability is reduced. Also, a human action with a high RAW but an error probability that is already low (less han about 1E-3) cannot, in most cases, be improved no matter how much the training or procedures are nhanced. However, a high RAW does indicate human actions for which training should not be reduced or rocedures made more complicated. Table 2 lists the top 15 human actions in order of highest to lowest RAW.

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To obtain the most useful information from these two ranked lists, both should be examined in combination for specific type of insights they provide. Please contact me or anyone in the PRA Group if you have any questions on how to apply this information. We will be happy to meet with you to discuss it.

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Reviewed By: 6/4/02
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Table 1: HEPs Sorted by F-V

HEP Identifier	Description	Point Estimate	F-V	RAW
HEP-HHR-EOP13-23	High Head Recirculation	1.25E-2	1.71E-1	14.5
HEP-ODC-EOP-3-21	Failure to depressurize intact Steam Generator after a SGTR	2.00E-2	1.59E-1	8.8
HEP-RHR-EOP13-23	Low Head Recirculation	2.45E-2	1.49E-1	6.9
HEP-RCS-CSPH1-12	Operator Fails to establish Feed and Bleed (no SI signal)	2.36E-2	1.26E-1	6.2
—HEP-CST-LOW-	Failure to recognize need for alternate feed for AFW after draining CST	3.90E-4	1.18E-1	303.7
125-HEP-EOP10-08	Failure to re-establish a battery charger after an undervoltage	4.20E-3	9.83E-2	24.3
REC-OPEN-CV0112	Failure to manually open CV-112B: RWST to charging	1.00E-1	6.25E-2	1.6
HEP-ECA-EOP31-32	Failure to cool down and depressurize	7.70E-3	4.52E-2	6.8
AF—HEP-CST-FW--	Failure to establish Fire Water backup AFW after draining CST	1.1E-2	3.67E-2	4.3
HEP-MS—EOP-3-02	Failure to diagnose a SGTR event	4.75E-3	3.38E-2	8.1
AF—HEP-CST-SW--	Failure to establish Service Water to AFW after draining CST	4.6E-3	3.21E-2	7.9
AF—HEP-MDP-Flow	Failure to manually control flow on MDAFW pumps after a loss of IA and Nitrogen	4.4E-2	2.9E-2	1.6
138-HEP-STARTG05	Failure to manually start and align G05	1.3E-1	2.77E-2	1.2
AF—HEP-CST-SWMD	Failure to establish service water backup to AFW after draining CST	1.5E-2	2.17E-2	2.4
REC-MAN-OPENVLV	Failure to manually open IA supply to containment	1E-1	2.12E-2	1.2
HEP-IA-FO-04748	Failure to re-open 3047 or 3048 valve after maintenance	1E-3	2.06E-2	21.6

: 2· HEPs Sorted by RAW

HEP Identifier	Description	Point Estimate	F-V	RAW
AF—HEP-CST-LOW-	Failure to recognize need for alternate feed for AFW after draining CST	3.90E-4	1.18E-1	303.7
125-HEP-EOP10-08	Failure to re-establish a battery charger after an undervoltage	4.20E-3	9.83E-2	24 3
HEP-RP—AOP9B-63	Operator fails to manually trip with a Component Cooling Water or Service Water transient	1.1E-4	2.06E-3	19.7
HEP-HHR-EOP13-23	High Head Recirculation	1.25E-2	1.71E-1	14.5
HEP-ODC-EOP-3-21	Failure to depressurize intact Steam Generator after a SGTR	2.00E-2	1.59E-1	8.8
HEP-MS—EOP-3-02	Failure to diagnose a SGTR event	4.75E-3	3.38E-2	8.1
HEP-RHR-EOP13-23	Low Head Recirculation	2.45E-2	1.49E-1	6.9
HEP-ECA-EOP31-32	Failure to cool down and depressurize	7.70E-3	4.52E-2	6.8
HEP-RCS-CSPH1-12	Operator Fails to establish Feed and Bleed (no SI signal)	2.36E-2	1.26E-1	6.2
HEP-CCW-EOP13-03	Failure to manually start CCS pump	1.2E-4	5.12E-4	5.3
AF—HEP-CST-FW—	Failure to establish Fire Water backup AFW after draining CST	1.1E-2	3.67E-2	4.3
–HEP-CST-SWMD	Failure to establish service water backup to AFW after draining CST	1.5E-2	2.17E-2	2.4
HEP-ODA-EOP12-05	Failure to cooldown and depressurize after a small LOCA	2.7E-3	3.77E-3	2.4
HEP-IA—FO-START	Failure to manually restart IA or SA	6.9E-4	5.82E04	1.8