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INTERNATIONAL

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PRESSURE LOSS CHARACTERISTICS FOR IN-CELL FLOW OF HELIUM IN PWR AND BWR MPC STORAGE CELLS

FOR

GENERIC

Holtec Report No: HI-2043285

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1.	Chapter 1	IR	12/28/04	101238	-	-	-	-	-	-
2.	Chapter 2	IR	12/28/04	701991	IR	6/13/05	227833	-	-	-
3.	Chapter 3	ER	12/28/04	216269	IR	6/13/05	162144	-	-	-
4.	Chapter 4	IR	12/28/04	298365	-	-	-	-	-	-
5.	Appendix B	IR	-	-	IR	6/13/05	180148	-	-	-
6.	Appendix C	IR	-	-	-	-	-	IR	2/17/06	789312
7.	Appendix D	-	-	-	-	-	-	-	-	-
8.										
9.										
11.										
12.										
13.										

†† Chapter or Appendix number. Main body of report includes Appendix A.

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No.	Document Portion††	REVISION No. 3			REVISION No. 4			REVISION No. 5		
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1.	Chapter 1	-	-	-	-	-	-	-	-	-
2.	Chapter 2	-	-	-	-	-	-	-	-	-
3.	Chapter 3	-	-	-	-	-	-	-	-	-
4.	Chapter 4	-	-	-	-	-	-	-	-	-
5.	Appendix B	-	-	-	-	-	-	-	-	-
6.	Appendix C	ER	05/03/2006	758170	IR	07/06/2006	373133	-	-	-
7.	Appendix D	-	-	-	-	-	-	IR	11/22/06	892416
8.										
9.										
11.										
12.										
13.										

†† Chapter or Appendix number. Main body of report includes Appendix A.

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DOCUMENT CATEGORIZATION

In accordance with the Holtec Quality Assurance Manual and associated Holtec Quality Procedures (HQPs), this document is categorized as a:

- ☐ Calculation Package[3] (Per HQP 3.2)
- ☒ Technical Report (Per HQP 3.2)(Such as a Licensing Report)
- ☐ Design Criterion Document (Per HQP 3.4)
- ☐ Design Specification (Per HQP 3.4)
- ☐ Other (Specify):

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3. Revisions to this document may be made by adding supplements to the document and replacing the "Table of Contents", this page and the "Revision Log".

SUMMARY OF REVISIONS LOG (Rev. 5) Summary of Changes: 3-Zone Fuel Flow Resistances Appendix D and Attachment 2 Added. (Number of Pages List)	
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1.1 About This Document

This work product has been labeled a *safety-significant* document in Holtec's QA System. In order to gain acceptance as a *safety significant* document in the company's quality assurance system, this document undergoes a prescribed review and acceptance process that requires the preparer and reviewer(s) of the document to answer a comprehensive list of questions crafted to ensure that the document has been purged of all errors of any material significance. A record of the review and verification activities is maintained in electronic form within the company's network to enable future retrieval and recapitulation of the programmatic validation process leading to the acceptance and release of this document under the company's QA system. Among the numerous requirements that a document of this genre must fulfill to muster approval within the company's QA program are:

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- All significant assumptions, as applicable, are stated.

- The analysis methodology, if utilized, is consistent with the physics of the problem.

- Any computer code and its specific versions that may be used in this work has been formally admitted for use within the company's QA system.

- The format and content of the document is in accordance with the applicable Holtec quality procedure.

- The material content of this document is understandable to a reader with the requisite academic training and experience in the underlying technical disciplines.

Once a safety significant document produced under the company's QA System completes its review and certification cycle, it should be free of any materially significant error and should not require a revision unless its scope of treatment needs to be altered. Except for regulatory interface documents (i.e., those that are submitted to the NRC in support of a license amendment request), revisions to Holtec *safety-significant* documents to amend grammar, to improve diction, or to add trivial calculations are made only if such editorial changes are warranted to prevent erroneous conclusions from being inferred by the reader. In other words, the focus in the preparation of this document is to ensure accuracy of the technical content rather than the cosmetics of presentation.

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fully documented such that the analyses can be reproduced at *any time in the future* by a specialist trained in the discipline(s) involved. Because of its function as a repository of all analyses performed on the subject of its scope, this document will require a revision only if an error is discovered in the computations or the equipment design is modified. Additional analyses in the future may be added as numbered supplements to this Package. Each time a supplement is added or the existing material is revised, the revision status of this Package is advanced to the next number and the Table of Contents is amended. Analysis reports are Holtec proprietary documents. They are shared with a client only under strict controls on their use and dissemination. This report is saved as a Permanent Record under the company's QA System.

HOLTEC APPROVED COMPUTER PROGRAM LIST

(Total No. of Pages = 5)

HOLTEC APPROVED COMPUTER PROGRAM LIST				REV. 73 September 9, 2004	
PROGRAM (Category)	**VERSION**	**CERTIFIED USERS**	**OPERATING SYSTEM**	**REMARKS**	**CODE USED**
ANSYS (A)	5.7,7.0	JZ, ER, PK, CWB, SPA, AIS, IR, SP, AK, SJ, RW, VRP	Windows		
AIRCOOL	5.2I, 6.1		Windows		
BACKFILL	2.0		DOS/ Windows		
BONAMI (Scale)	4.3, 4.4		Windows		
BULKTEM	3.0		DOS/ Windows		
CASMO-4 (A)	1.13.04 (UNIX), 2.05.03 (WINDOWS)	ERD, SPA, DMM, KC, ST,VJB	UNIX/ Windows	Version 1.13.04 should not be used for new projects and should only be used when necessary for additional calculations on previous projects. The user should refer to the error notice documented in c4ser.04-results.pdf located in \generic\library\ nuclear\error notices\ concerning the use of version 1.13.04. Library N should be used with version 2.05.03 for all new reports issued after June 1st, 2003. Revisions to reports issued prior to June 1st, 2003 may continue to use the old Library L.	
CASMO-3 (A)	4.4, 4.7	ERD, SPA, DMM, KC, ST	UNIX		
CELLDAN	4.4.1		Windows		
CHANBP6 (A)	1.0	SJ, PK, CWB, AIS, SP,AK	DOS/Windows		
CHAP08 (CHAPLS10)	1.0		Windows		
CONPRO	1.0		DOS/Windows		
CORRE	1.3		DOS/Windows		
DECAY	1.4, 1.5		DOS/Windows		
DÉCOR	1.0		DOS/Windows		

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September 9, 2004

PROGRAM (Category)	VERSION	CERTIFIED USERS	OPERATING SYSTEM	REMARKS	CODE USED
DR.BEAMPRO	1.0.5		Windows		
DR.FRAME	2.0		Windows		
DYNAMO (A)	2.51	AIS, SP, CWB, PK, SJ	DOS/Windows	Personnel qualified to use MR216 are automatically qualified to use DYNAMO.	
DYNAPOST	2.0		DOS/Windows		
FIMPACT	1.0		DOS/Windows		
FLUENT (A)	4.32, 4.56, 6.1.18	ER, IR, DMM, SPA	Windows	Do not use porous medium with zero velocity.	6.1.18 6.2.16
FTLOAD	1.4		DOS		
GENEQ	1.3		DOS		
HXFLOW	1.0		DOS/Windows		
INSYST	2.01		Windows		
KENO-5A (A)	4.3, 4.4	ERD, SPA, DMM, KC, ST,VJB	Windows		
LONGOR	1.0		DOS/Windows		
LNSMTH2	1.0		DOS/Windows		
LS-DYNA3D (A)	936, 940, 950, 960, 970	JZ, AIS, SPA, SP, KPS,VRP	Windows		
MAXDISP8	1.8		DOS/Windows		
MAXDIS16	1.0		DOS/Windows		
MCNP (A)	4A, 4B	ERD, SPA, KC,ST,DMM, VJB, MAP	Windows/ UNIX	CASMO-4 Lumped Fission Products (IDs 401 and 402) and Isotope Pm148M (ID 61248) can be modeled in MCNP 4A using the cross sections documented in HI-2033031. Use of these cross sections is restricted to MCNP 4A, and to material specifications in atom densities.	
MASSINV	1.4, 1.5, 2.1		DOS/Windows		
MR2	1.7	AIS, SP, CWB, PK, SJ	DOS/Windows	For use in wet storage analysis only.	

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PROGRAM (Category)	**VERSION**	**CERTIFIED USERS**	**OPERATING SYSTEM**	**REMARKS**	**CODE USED**
MR216 (A)	1.0, 2.0, 2.2,2.4	AIS, SP, CWB, PK, SJ,AK	DOS/Windows	Versions 2.2 and 2.4 for use in dry storage analyses only. Use DYNAMO for liquefaction problems.	
MSREFINE	1.2,1.3, 2.1		DOS/Windows		
MULPOOLD	2.1		DOS/Windows		
MULTI1	1.3, 1.4, 1.5, 1.54, 1.55		Windows		
NITAWL (Scale)	4.3, 4.4		Windows		
NASTRAN DESKTOP (WORKING MODEL)	6.2, 2001,6.4,2002, 2003,2004		Windows		
ONEPOOL	1.4.1, 1.5, 1.6		DOS/Windows		
ORIGENS (Scale)	4.3, 4.4		Windows		
PD16	1.1, 1.0,2.1		Windows		
PREDYNA1	1.5, 1.4		DOS/Windows		
PREMULT8	1.0		DOS/Windows		
PRESPRG8	1.0		DOS/Windows		
PSD1	1.0		DOS/Windows		
QAD	CGGP		DOS/Windows		
SAS2H (Scale)	4.3, 4.4		Windows		
SFMR2A	1.0		DOS/Windows		
SHAPEBUILDER	3.0		DOS/Windows		
SIFATIG	1.0		DOS/Windows		

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PROGRAM (Category)	**VERSION**	**CERTIFIED USERS**	**OPERATING SYSTEM**	**REMARKS**	**CODE USED**
SOLIDWORKS	2001PLUS, 2003		DOS/Windows	This program may be used to calculate Weight, Volume, Centroid and Moment of Inertia. As a precaution, user should avoid keeping more than one drawing files open at any given time during a Solidworks session. If there is a need for multiples drawing files to be open at once, user should ensure that the part names for all open files are uniquely named (i.e. no two parts have the same name.)	
SPG16	1.0, 2.0, 3.0		DOS/Windows		
SHAKE2000	1.1.0, 1.4.0		DOS/Windows		
STARDYNE (A)	4.4, 4.5	SP	Windows		
STER	5.04		Windows		
TBOIL	1.7, 1.9		DOS/Windows	See HI-92832 for restriction on v1.7.	
THERPOOL	1.2, 1.2A		DOS/Windows		
TRIEL	2.0		DOS/Windows		
VERSUP	1.0		DOS		
VIB1DOF	1.0		DOS/Windows		

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PROGRAM (Category)	**VERSION**	**CERTIFIED USERS**	**OPERATING SYSTEM**	**REMARKS**	**CODE USED**
VMCHANGE	1.4, 1.3		Windows		
WEIGHT	1.0		Windows		

NOTES:
1. XXXX = ALPHANUMERIC COMBINATION
2. GENERAL PURPOSES UTILITY CODES (MATHCAD, EXCEL, ETC.) MAYBE USED ANYTIME.

Appendix C: Fuel Resistance Calculations by Shear Stress Method

Appendix D: 3-Zone Flow Resistance Calculations

ATTACHMENT 2

Shear Stress Post-processing Notes