				R
PROGRAM	RECEN	IT		Re
				Re
VERSION	79-1	(OCTOBER 1979)	CDC-7600	Re
VERSION	80-1	(MAY 1980)	IBM, CDC AND CRAY VERSION	Re
VERSION	80-2	(DECEMBER 1980)	IMPROVED TREATMENT OF UNRESOLVED	Re
			REGION TO COMPUTE ALL REACTIONS AT	Re
			THE SAME TIME.	R
VERSION	81-1	(MARCH 1981)	IMPROVED BASED ON USER COMMENTS.	R
VERSION	81-2	(AUGUST 1981) A	ADDED MONITOR MODE. ADDED SPEED OPTION	R
		5	TO BYPASS BACKWARDS THINNING IF FILE 3	R
			ALLOWABLE ERROR = 0.0 (NOTE THIS OPTION	R
			NILL RESULT IN ALL TABULATED POINTS	R
			FROM THE EVALUATION BEING KEPT IN THE	R
			OUTPUT FROM THIS PROGRAM).	R
			IMPROVED COMPUTER COMPATIBILITY.	R
VERSION	83-1	-	*MAJOR RE-DESIGN.	R
			*PAGE SIZES INCREASED.	R
			*ELIMINATED COMPUTER DEPENDENT CODING.	
			*NEW, MORE COMPATIBLE I/O UNIT NUMBERS.	
		-	*ADDED OPTION TO KEEP ALL RECONSTRUCTED	
			AND BACKGROUND ENERGY POINTS. *ADDED STANDARD ALLOWABLE ERROR OPTIONS	R
			(CURRENTLY 0.1 PER-CENT RECONSTRUCTION	
			AND 0.0 PER-CENT THINNING).	R
VERSION	83-2	(OCTOBER 1983)	IMPROVED BASED ON USER COMMENTS.	R
			IMPROVED INTERVAL HALFING CONVERGENCE.	
			*A BRAND NEW PROGRAM WHICH COMPLETELY	R
		(SUPERCEDES ALL PREVIOUS VERSIONS OF	R
			THIS PROGRAM.	R
		1	*UPDATED FOR ENDF/B-VI FORMATS.	R
		,	*ADDED GENERAL REICH-MOORE FORMALISM	R
			(WITH TWO FISSION CHANNELS).	R
		1	*DECREASED RUNNING TIME.	R
		1	*SPECIAL I/O ROUTINES TO GUARANTEE	R
			ACCURACY OF ENERGY.	R
		,	*DOUBLE PRECISION TREATMENT OF ENERGY	R
			(REQUIRED FOR NARROW RESONANCES).	R
		• •	*FORTRAN-77/H VERSION	R
			*ENERGY DEPENDENT SCATTERING RADIUS	R
VERSION	86-2	(JUNE 1986) '	*IF FIRST CHANCE FISSION (MT=19)	R
			BACKGROUND IS PRESENT ADD RESONANCE	R
VEDOTON	96.3		CONTRIBUTION OF FISSION TO IT.	R
VERSION	00-3	(OCIOPER 1980),	*MULTI-LEVEL OR REICH-MOORECORRECT POTENTIAL SCATTERING CROSS SECTION FOR	R
			MISSING AND/OR FICTICIOUS (L,J)	R
			SEQUENCES.	R
VERSTON	87-1	(TANIJARY 1987)	*IMPROVED COMBINING FILE 2+3	R
			CORRECTED ADLER-ADLER CALCULATIONS.	R
	-	• • • •	*UPDATED REICH-MOORE ENDF/B-VI FORMAT	R
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	TO BE THE SAME AS REICH-MOORE FORMAT	R
			IN EARLIER VERSIONS OF ENDF/B FORMAT.	R
		1	*CHECK FOR PRELIMINARY ENDF/B-VI	R
			REICH-MOORE FORMAT (NOW ABANDONED)	R
			AND TERMINATE EXECUTION IF DATA IS	R
			IN THIS FORMAT.	R
		,	*CALCULATE CHANNEL RADIUS OR SET IT	R
			EQUAL TO THE SCATTERING RADIUS.	R
		,	*IMPLEMENTED HYBRID R-FUNCTION WITH THE	R
			FOLLOWING RESTRICTIONS	R
			FOLLOWING RESTRICTIONS - ONLY INELASTIC COMPETITION (NO	R R

				- NO TABULATED FILE 2 BACKGROUND	Pocort
				- NO TABULATED FILE 2 BACKGROUND - NO TABULATED OPTICAL MODEL PHASE	Recent Recent
				SHIFT	
					Recent
				*PROGRAM EXIT IF GENERAL R-MATRIX IN	Recent
				THE EVALUATION (THIS FORMALISM WILL BE IMPLEMENTED ONLY AFTER THE AUTHOR	Recent
				RECEIVES REAL EVALUATIONS WHICH USE	Recent
					Recent
				THIS FORMALISMUNTIL THEN IT IS	Recent
				IMPOSSIBLE TO ADEQUATELY TEST THAT	
					Recent
				CORRECT).	Recent
				*INCREASED MAXIMUM NUMBER OF RESONANCES	
				FROM 1002 TO 4008.	Recent
					Recent
				LIMITS.	Recent
				*FILE 2 AND FILE 3 ENERGIES WHICH ARE	
				NEARLY EQUAL ARE TREATED AS EQUAL	
				. ,	Recent
				*CHECK FILE 3 BACKGROUND CROSS SECTIONS	
				IN EDIT MODE.	Recent
				*OPTIONINTERNALLY DEFINE FILENAMES	
	TEDOTON	00 1	(TANTIADY 1000)	(SEE SUBROUTINE FILEIO FOR DETAILS).	
	VERSION	89-1	(JANUARI 1989)	*PSYCHOANALYZED BY PROGRAM FREUD TO	Recent
				INSURE PROGRAM WILL NOT DO ANYTHING CRAZY.	Recent
				*UPDATED TO USE NEW PROGRAM CONVERT	Recent
				KEYWORDS.	Recent Recent
				*CORRECTED MULTILEVEL, REICH-MOORE AND	
				HYBRID R-FUNCTION POTENTIAL SCATTER	Recent
				TO ACCOUNT FOR REPEATED J-VALUES FOR	
					Recent
					Recent
				CONVENTIONS.	Recent
				*UPDATED TO USE NEW ENDF/B-VI	Recent
				•	Recent
				RESONANCE CONTRIBUTION TO ALREADY	
					Recent
					Recent
				-	Recent
	VERSION	90-1	(JUNE 1990)		Recent
					Recent
				*NEW MORE CONSISTENT ENERGY OUTPUT	Recent
				ROUTINE	Recent
	VERSION	91-1	(JULY 1991)	*NEW UNIFORM TREATMENT OF ALL RESONANCE	Recent
				FORMALISMS (SEE, COMMENTS BELOW)	Recent
				*NEW REICH-MOORE ALGORITHM	Recent
				*MORE EXTENSIVE ERROR CHECKING AND	Recent
				ERROR MESSAGE EXPLANATIONS	Recent
•	VERSION	92-1	(JANUARY 1992)	*MAJOR RESTRUCTING TO IMPROVE ACCURACY	Recent
				AND COMPUTER INDEPENDENCE.	Recent
				*INCREASED ENERGY POINT PAGE SIZE FROM	Recent
				1002 TO 4008.	Recent
				*NO MORE THAN 2 ENERGY POINTS WHERE	Recent
				CROSS SECTION IS ZERO AT BEGINNING	Recent
				OF A SECTION FOR EACH REACTION, E.G.,	Recent
				THRESHOLD FISSION.	Recent
				*PROCESS ONLY A PORTION OF RESONANCE	Recent
					Recent
				*ALL ENERGIES INTERNALLY ROUNDED PRIOR	Recent
				TO CALCULATIONS.	Recent
				*COMPLETELY CONSISTENT I/O AND ROUNDING	Recent
				ROUTINES - TO MINIMIZE COMPUTER	Recent
				DEPENDENCE.	Recent

VERSION 93-1	(MADCH 1002) ·	*UPDATED REICH-MOORE TREATMENT TO USE	Recent
			Recent
		20040 DATA POINTS.	Recent
		*INCREASED MAXIMUM NUMBER OF RESONANCES	
			Recent
VEDSTON 04-1	(TANILADY 1004)	*VARIABLE ENDF/B DATA FILENAMES	Recent
VERDION 94 1	(URIORICI 1554)	TO ALLOW ACCESS TO FILE STRUCTURES	Recent
		(WARNING - INPUT PARAMETER FORMAT	Recent
		HAS BEEN CHANGED).	Recent
			Recent
		(SEE, SUBROUTINE ENDIT)	Recent
VERSION 94-2	(AUGUST 1994)	*CORRECTED ADDJ FOR ENERGY DEPENDENT	Recent
VERDION 94 2	(A06051 1554)		Recent
VERSION 96-1	(.TANIIARY 1996)		Recent
VERDION JU I	(URNORICI 1990)		Recent
			Recent
VERSION 97-1	(ADDTT. 1997)		Recent
VERDION 57 I	(AFRID 1997)		Recent
			Recent
		120000 DATA POINTS.	Recent
		*INCREASED MAXIMUM NUMBER OF RESONANCES	
			Recent
VERSION 99-1	(MARCH 1999)		Recent
VERSION 99-1	(MARCH 1999)		Recent
			Recent
		VERSION BASED ON RECENT FORMAT CHANGE	
			Recent
VERSION 99-2	(JUNE 1999)	*IMPLEMENTED NEW REICH-MOORE FORMALISM	
		TO ALLOW DEFINITION OF (L. L.S) FOR	
		TO ALLOW DEFINITION OF (L,J,S) FOR EACH SEQUENCE	Recent
		EACH SEQUENCE.	Recent Recent
		EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING	Recent Recent Recent
		EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.	Recent Recent Recent Recent
		EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON	Recent Recent Recent Recent Recent
VERS. 2000-1	(FEBRUARY 2000)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK	Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS	Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS	Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT	Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h'	Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY	Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS.	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT ABOVE L = 5 TO INFINITY.	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT ABOVE L = 5 TO INFINITY. *ADDED QUICK CALCULATION - IF THE	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT ABOVE L = 5 TO INFINITY.	Recent Recent
VERS. 2000-1 VERS. 2002-1	(FEBRUARY 2000) (MAY 2002) (SEPT. 2002)	EACH SEQUENCE. *ASSUME ENDF/B-VI, NOT V, IF MISSING MF=1, MT-451.)*GENERAL IMPROVEMENTS BASED ON USER FEEDBACK *OPTIONAL INPUT PARAMETERS *OUTPUT RESONANCE WITH 9 DIGITS *TO BE C AND C++ COMPATIBLE OUTPUT *ADDED INCLUDE 'recent.h' *MADE ENDF/B-VII READY *UPDATED FOR NEW REICH-MOORE LRF=7 PARAMETERS WITH COMPETITION *ADDED COULOMB PENETRATION FACTORS FOR LRF=7 COMPETITIVE CHANNELS. *EXTENDED DEFINITIONS OF PENETRATION FACTOR, LEVEL SHIFT FACTOR, AND POTENTIAL SCATTERING PHASE SHIFT ABOVE L = 5 TO INFINITY. *ADDED QUICK CALCULATION - IF THE INPUT ALLOWABLE ERROR IS 1.0 OR MORE (100 % OR MORE) THERE IS NO ITERATION	Recent Recent

			QUICKLY CALCULATED ONLY AT A FIXED SET OF ENERGY POINTS, BASED ON THE	Recent Recent
			ENERGY AND WIDTH OF ALL RESONANCES.	Recent
			THIS CAN BE USED TO QUICKLY "SEE"	Recent
			NEW EVALUATIONS THAT MAY CONTAIN	Recent
			ERRORS, THAT WOULD OTHERWISE CAUSE	Recent
			THIS CODE TO RUN FOR AN EXCESSIVELY	Recent
VEDC	2005 1	(TINE 2005)	LONG TIME.	Recent
VERS.	2005-1	(JUNE 2005)	*ADDED ENERGY DEPENDENT SCATTERING	Recent
			RADIUS FOR ALL RESONANCE TYPES	Recent
VEDC	2007 1	(TAN 2007)	(EARLIER ONLY BREIT-WIGNER ALLOWED).	Recent
VERS.	2007-1	(JAN. 2007)	*CHECKED AGAINST ALL ENDF/B-VII. *DECOUPLED PAGE SIZE FROM MAX. # OF	Recent
			RESONANCES.	Recent Recent
			*INCREASED PAGE SIZE FROM 120,000 TO	Recent
			750,000 DATA POINTS.	Recent
			*KEPT MAX. # OF RESONANCE AT 120,000.	Recent
			*CORRECTED ALL BACKGROUND = 0 CASE	Recent
VERS	2007-2	(OCT. 2007)	*NO MT=19 OUTPUT IF NO BACKGROUND,	Recent
V LIKO .	2007 2	(001. 2007)	REGARDLESS OF INPUT OPTION.	Recent
			*72 CHARACTER FILE NAMES.	Recent
VERS	2008-1	(FEB. 2008)	*CORRECTED NAPS ERROR - NOW DEFINE FOR	
V LIKO .	2000 1	(110. 2000)	ALL TYPES OF PARAMETERS - EARLIER	Recent
			ONLY DEFINED FOR B-W PARAMETERS.	Recent
VERS.	2008-2	(APRIL 2008)		Recent
		(DEFINE RHOX2 AT EACH RESONANCE USING	
			SETRHO1 BEFORE ENERGY DEPENDENT	Recent
			CALCULATION.	Recent
			*ADDED PRECISION TO RESONANCE PROFILE	Recent
			IN SUBROUTINE SUBINT	Recent
VERS.	2009-1	(JULY 2009)	*NEW REICH-MOORE COMPETITIVE WIDTHS -	Recent
			IF CHARGED PARTICLE REACTION (MT=103	Recent
			THROUGH 107) WILL ADD RESONANCE	Recent
			CONTRIBUTION TO COMPETITIVE MT AND IF	Recent
			PRESENT, THE GROUND LEVEL, $MT = 600$	Recent
			THROUGH 800. IF COMPETITIVE CHANNEL	Recent
			IS mt=4 (TOTAL N.N') IT WILL ALSO ADD	Recent
			COMPETITIVE RESONANCE CONTRIBUTION TO	Recent
			MT=50 (N,N' GROUND).	Recent
			*NEW REICH-MOORE - SUM COMPETITIVE	Recent
			WIDTHS IF ALL FOR THE SAME STATE (MT)	
VERS.	2009-2	(AUG. 2009)	*RE-WRITE TO USE 12, RATHER THAN 6,	Recent
			PAAMETERS PER RESONANCE.	Recent
			*MAJOR RE-WRITE TO ACCOMODATE GENERAL	
			REICH-MOORE (LRF=7).	Recent
			*COMPLETE RE-WRITE FOR ADLER-ADLER	Recent
			AND HRF (N O LONGER USED IN ENDF/B) TO USE 12 PARAMETERS PER RESNANCE.	Recent
VEDC	2010-1	(April 2010)	*ADDED SAMRML LOGIC TO HANDLE ALL	Recent Recent
vero.	2010-1	(PDIII 2010)	LRF=7 CASES.	Recent
			*EXTENDED SAMRML LOGIC TO PROCESS ALL	
			EVALUATIONS = RESOLVED + UNRESOLVED +	
			TABULATED - SAMRML ONLY DOES ONE	Recent
			SECTION OF RESOLVED LRF=7 DATA	Recent
			WITHOUT TABULATED BACKGROUND.	Recent
			*UPDATED ELASTIC POTENTIAL CALCULATION	
			FOR TOTAL (SLBW) AND CORRECTION FOR	Recent
			MISSING SEQUENCES (MLBW, RM, HRF).	Recent
			*ADDED HIDDEN (OPTIONAL) UNRESOLVED	Recent
			COMPETITION LISTING (NOT ENDF/B).	Recent
			*ADDED BOB MACFARLANE'S PROPOSAL - USE	Recent
			LRX TO DEFINE COMPETITIVE L VALUE -	Recent
			COMPETITIVE $L = LRX - 1$, IF $LRX > 0$.	Recent

		/		*CHECKED FOR NEGATIVE WIDTHS.	Recent
VERS.	2012-1	(Nov.	2012)	*ADDED ENERGY DEPENDENT STEP SIZE	Recent
				FOR STARTING GRID AROUND RESONANCES.	Recent
				*Added CODENAME	Recent
				*32 and 64 bit Compatible	Recent Recent
				*Added ERROR stops *Check for no capture for Reich-Moore.	
FDC	2012-2	(Now	2012)	*Eliminated ERROR in NHIGH(0) index.	Recent
	2012-2		2012)	*Extended OUT9.	Recent
	2015-1	-	2015)	*Multiple LRF=7, General Reich-Moore	Recent
<u>ыю</u> .	2013 1	(oun.	2013)	Resonance Regions.	Recent
				*Added OUT10.	Recent
				*Replaced ALL 3 way IF Statements.	Recent
				*Replaced ALL LOGICAL by INTEGER.	Recent
ERS.	2016-1	(Jan.	2016)	*Do not Change LSSF during the	Recent
		(,	reconstruction - for compatibility	Recent
				with later URR treatment.	Recent
				*Insured that all ERROR stops print	Recent
				a message explaining why the code	Recent
				stopped.	Recent
				*Partial Energy Range Processing	Recent
				no longer allowed - today's computers	Recent
				are so fast that this option is now	Recent
				out-of-date and no longer allowed.	Recent
				*L-Value dependent fission = Earlier	Recent
				was done only by entire isotope.	Recent
				*Denser Starting Energy Grid.	Recent
ERS.	2017-1	(May	2017)	*Corrected ERROR in LRF=3 treatment.	Recent
				This ERROR only existed in version	Recent
				2016-1, which was never released to	Recent
				the general public, so it will not	Recent
				effect any results calculated by code	Recent
				users.	Recent
				*All floating input parameters changed	Recent
				to character input + IN9 conversion.	Recent
				*Added points to starting energy grid	Recent
				to approximate the shape of each	Recent
				resonance = based on comparisons of	Recent
				0.01% to 0.1% results.	Recent
				*Increased max. points to 1,200,000.	Recent
				*LRF=7 Shift option no longer allowed	Recent
				Set = 0, print WARNING and continue.	Recent
				*Corrected COMMON/NAPRHO/NRO, NAPS	Recent
				/NAPRHO/ mispelled - Freud found.	Recent
	NA T107				Recent
WNED	, MAINTA	AINED A	ND DISTRI	IBUTED BY	Recent
					Recent
	UCLEAR I			ACENCY	Recent
	NATIONAL BOX 100	ATOMIO	C ENERGY	AGENCI	Recent Recent
	BOX 100 0, VIENN	ום אוזפי	TRTA		Recent
UROP	•	AUS	-1114		Recent
JOINOP.	-				Recent
RTCT	NALLY WF	י האיתיתיד	BY		Recent
TOTI	WF				Recent
		illen			Recent
	++ E C.				Recent
)ermo	tt E. Cu				Recent
		CT TNE			
	tt E. Cu NT CONTA	CT INF	ORMATION		KACANT
RESE	NT CONTA				Recent
PRESE	NT CONTA	ıllen	ORMATION		Recent
PRESE Dermo	NT CONTA tt E. Cu Hudson W	illen Nay			Recent Recent
PRESE Dermo	NT CONTA tt E. Cu Hudson W more, CA	illen Nay			Recent

Telephone 925-443-1911 E. Mail RedCullen1@Comcast.net Website RedCullen1.net/HOMEPAGE.NEW Acknowledgement (Version 2004-1) The author thanks Nancy Larson, ORNL, for providing her SAMRML code for comparison to RECENT output for Reich-Moore evaluations, in particular to verify results for the new LFR=7 evaluations. I also thank her for providing guidance to help me understand and implement this new teatment for Reich-Moore parameters. ACKNOWLEDGEMENT (VERSION 92-1) THE AUTHOR THANKS SOL PEARLSTEIN (BROOKHAVEN NATIONAL LAB) FOR SIGNIFICANTLY CONTRIBUTING TOWARD IMPROVING THE ACCURACY AND COMPUTER INDEPENDENCE OF THIS CODE - THANKS, SOL	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent
AUTHORS MESSAGE	Recent Recent
THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY THE COMMENTS CONCERNING MACHINE DEPENDENT CODING. AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR COMPUTER.	Recent Recent Recent Recent Recent
THIS PROGRAM IS DESIGNED TO RECONSTRUCT THE RESONANCE CONTRIBUTION TO THE CROSS SECTION IN LINEARLY INTERPOLABLE FORM, ADD IN ANY LINEARLY INTERPOLABLE BACKGROUND CROSS SECTION AND OUTPUT THE RESULT IN THE ENDF/B FORMAT. THE CROSS SECTIONS OUTPUT BY THIS PROGRAM WILL BE LINEARLY INTERPOLABLE OVER THE ENTIRE ENERGY RANGE	Recent Recent Recent Recent
THE RESONANCE CONTRIBUTION IS CALCULATED FOR TOTAL (MT=1), ELASTIC (MT=2), CAPTURE (MT=102) AND FISSION (MT=18), ADDED TO THE BACKGROUND (IF ANY) AND OUTPUT. IN ADDITION, IF THERE IS A FIRST CHANCE FISSION (MT=19) BACKGROUND PRESENT THE RESONANCE CONTRIBUTION OF FISSION WILL BE ADDED TO THE BACKGROUND AND OUTPUT. IF THERE IS NO FIRST CHANCE FISSION (MT=19) BACKGROUND PRESENT THE PROGRAM WILL NOT OUTPUT MT=19.	Recent Recent Recent Recent Recent Recent Recent
IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGYENDF/B TAPEWILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, DISK OR ANY OTHER MEDIUM.	Recent Recent Recent Recent
PROCESSING DATA IN THE ENDF/B-VI FORMAT	Recent Recent
IT HAS NOW BEEN CONFIRMED (PRIVATE COMMUNICATION, CHARLES DUNFORD, APRIL, 1991) THAT THE PROPER PROCEDURE TO FOLLOW WHEN THERE ARE MISSING OR DUPLICATE J VALUES IS TO IN ALL CASES ADD A SEQUENCE WITH NO RESONANCES TO ACCOUNT FOR THE CONTRIBUTION OF THE SEQUENCE TO THE POTENTIAL SCATTERING CROSS SECTION.	Recent Recent Recent

Recent THIS IS THE PROCEDURE WHICH WAS FOLLOWED BY ALL VERSIONS OF RECENT Recent SINCE 86-3 AND WILL CONTINUE TO BE THE PROCEDURE. Recent Recent INPUT ENDF/B FORMAT AND CONVENTIONS Recent Recent. ENDF/B FORMAT Recent Recent THIS PROGRAM ONLY USES THE ENDF/B BCD OR LINE IMAGE FORMAT (AS Recent OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Recent OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV, V OR VI FORMAT). Recent Recent IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B Recent FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS Recent ASSUMED THAT THE MAT, MF AND MT ON EACH LINE IS CORRECT. SEQUENCE Recent NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE Recent CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 Recent AND ALL SECTIONS OF MF=2 AND 3 MUST BE CORRECT. THE PROGRAM COPIES Recent ALL OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE Recent TO THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS. Recent Recent ENDF/B FORMAT VERSION Recent _____ Recent THE FORMATS AND CONVENTIONS FOR READING AND INTERPRETING THE DATA Recent VARIES FROM ONE VERSION OF ENDF/B TO THE NEXT. HOWEVER, IF THE Recent HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IT IS POSSIBLE FOR Recent THIS PROGRAM TO DISTINGUISH BETWEEN DATA IN THE ENDF/B-IV, V AND Recent VI FORMATS AND TO USE THE APPROPRIATE CONVENTIONS FOR EACH Recent ENDF/B VERSION (SEE, SUBROUTINE FILE1 FOR A DESCRIPTION OF HOW Recent THIS IS DONE). IF THE HOLLERITH SECTION IS NOT PRESENT THE Recent PROGRAM WILL ASSUME THE DATA IS IN THE ENDF/B-VI FORMAT AND USE Recent ALL CONVENTIONS APPROPRIATE TO ENDF/B-V. USERS ARE ENCOURAGED TO Recent INSURE THAT THE HOLLERITH SECTION (MF=1, MT=451) IS PRESENT IN Recent ALL EVALUATIONS. Recent Recent INPUT OF ENERGIES Recent Recent ALL ENERGIES ARE READ IN DOUBLE PRECISION (BY SPECIAL FORTRAN I/O Recent ROUTINES) AND ARE TREATED IN DOUBLE PRECISION IN ALL CALCULATIONS. Recent Recent OUTPUT ENDF/B FORMAT AND CONVENTIONS Recent ====== Recent _____ CONTENTS OF OUTPUT Recent _____ Recent ENTIRE EVALUATIONS ARE OUTPUT, NOT JUST THE RECONSTRUCTED FILE Recent 3 CROSS SECTIONS, E.G. ANGULAR AND ENERGY DISTRIBUTIONS ARE Recent ALSO INCLUDED. Recent Recent DOCUMENTATION Recent _____ Recent THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED Recent BY THE ADDITION OF COMMENT CARDS AT THE END OF EACH HOLLERITH Recent SECTION IN THE FORM Recent Recent Recent RESONANCE CONTRIBUTION RECONSTRUCTED TO WITHIN 0.100 PER-CENT Recent COMBINED DATA NOT THINNED (ALL RESONANCE + BACKGROUND DATA KEPT) Recent Recent THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, SIGMA1 AND GROUPY) Recent REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON Recent THE DATA, INCLUDING WHICH VERSION OF EACH PROGRAM WAS USED. Recent Recent THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Recent

I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Recent OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF Recent EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 Recent IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF Recent THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF Recent MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO Recent DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND Recent AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT Recent SHOULD BE USED TO CREATE A HOLLERITH SECTION. Recent Recent REACTION INDEX Recent _____ Recent THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN Recent SECTION MF=1, MT=451 OF EACH EVALUATION. Recent Recent. THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451. Recent THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT Recent REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Recent NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING Recent A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE Recent A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Recent YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX. Recent Recent OUTPUT FORMAT OF ENERGIES Recent Recent _____ IN THIS VERSION OF RECENT ALL FILE 3 ENERGIES WILL BE OUTPUT IN Recent F (INSTEAD OF E) FORMAT IN ORDER TO ALLOW ENERGIES TO BE WRITTEN Recent WITH UP TO 9 DIGITS OF ACCURACY. IN PREVIOUS VERSIONS THIS WAS AN Recent OUTPUT OPTION. HOWEVER USE OF THIS OPTION TO COMPARE THE RESULTS Recent OF ENERGIES WRITTEN IN THE NORMAL ENDF/B CONVENTION OF 6 DIGITS Recent TO THE 9 DIGIT OUTPUT FROM THIS PROGRAM DEMONSTRATED THAT FAILURE Recent TO USE THE 9 DIGIT OUTPUT CAN LEAD TO LARGE ERRORS IN THE DATA Recent JUST DUE TO TRANSLATION OF ENERGIES FROM THEIR INTERNAL (BINARY) Recent REPRESENTATION TO THE ENDF/B FORMAT. Recent Recent ACCURACY OF ENERGY Recent Recent IN ORDER TO ALLOW ENERGIES TO BE ACCURATELY OUTPUT TO 9 DIGITS Recent ON SHORT WORD LENGTH COMPUTERS (E.G. IBM) ALL ENERGIES AND Recent ENERGY DEPENDENT TERMS ARE READ AND TREATED IN DOUBLE PRECISION. Recent Recent OUTPUT OF RESONANCE PARAMETERS Recent ------Recent A SPECIAL CONVENTION HAS BEEN INTRODUCED REGARDING RESONANCE Recent PARAMETERS. IN ORDER TO ALLOW THE USER TO DOPPLER BROADEN AND/OR Recent SELF-SHIELD CROSS SECTIONS THE RESONANCE PARAMETERS ARE ALSO Recent INCLUDED IN THE OUTPUT WITH THE EVALUATION. IN ORDER TO AVOID THE Recent POSSIBILITY OF ADDING THE RESONANCE CONTRIBUTION A SECOND TIME Recent TWO CONVENTIONS HAVE BEEN ADOPTED TO INDICATE THAT THE RESONANCE Recent CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 CROSS SECTIONS. Recent Recent (1) WHEN THE DATA IS PROCESSED BY THIS PROGRAM LRP (IN MF=1, Recent MT=451) IS SET EQUAL TO 2. THIS IS A CONVENTION WHICH HAS BEEN Recent ADOPTED AS A STANDARD CONVENTION IN ENDF/B-VI, BUT IS ONLY TO BE Recent USED FOR PROCESSED DATA, AS OPPOSED TO THE ORIGINAL EVALUATIONS. Recent IN EVALUATIONS WHICH CONTAIN MF=1, MT=451 LRP CAN BE USED TO Recent DETERMINE IF THE MATERIAL HAS BEEN PROCESSED. Recent Recent (2) THE LRU FLAG IN EACH SECTION OF FILE 2 DATA IS CHANGED TO Recent LRU=LRU+3. FOR EXAMPLE WHEN READING AN ENDF/B EVALUATION LRU=0 Recent (NO RESONANCES), =1 (RESOLVED) OR =2 (UNRESOLVED) INDICATES THAT Recent

THE DATA IS IN THE ORIGINAL ENDF/B FORM. LRU=3 (NO RESONANCES),

=4 (RESOLVED) OR =5 (UNRESOLVED) INDICATES THAT THE RESONANCE

Recent

CONTRIBUTION HAS ALREADY BEEN ADDED TO THE FILE 3 DATA. THIS Recent SECOND CONVENTION HAS BEEN ADOPTED AS INSURANCE THAT THE RESONANCE Recent CONTRIBUTION WILL NOT BE ADDED TWICE, EVEN FOR EVALUATIONS WHICH Recent DO NOT CONTAIN MF=1, MT=451 (EVALUATIONS WHICH CONTAIN MF=1, Recent MT=451 ARE COVERED BY CONVENTION (1), DESCRIBED ABOVE). Recent Recent UNIFORM TREATMENT OF RESONANCE FORMALISMS Recent = Recent NORMALIZATION Recent Recent ALL OF THE RESONANCE FORMALISMS INCLUDE A FACTOR OF, Recent Recent PI*(FRACTIONAL ABUNDANCE)/(K**2) Recent Recent THIS FACTOR HAS BEEN REMOVED FROM THE CALCULATION OF EACH TYPE Recent OF RESONANCE FORMALISM AND IS APPLIED AS A FINAL NORMALIZATION Recent AFTER THE CALCULATION, ONLY ONE PLACE IN THIS PROGRAM. Recent Recent FOR SIMPLICITY THIS TERM IS NOT INCLUDED IN THE FOLLOWING Recent DERIVATIONS - IN ALL CASES THE ACTUAL CROSS SECTION IS A PRODUCT Recent OF THE ABOVE FACTOR TIMES THE RESULTS PRESENTED BELOW. Recent Recent SIMILARITIES Recent _____ Recent FOR THE RESOLVED RESONANCE REGION, EXCEPT FOR SINGLE LEVEL BREIT Recent WIGNER, PARAMETERS ALL OF THE FORMALISMS DEFINE THE CROSS SECTIONS Recent IN AN EQUIVALENT FORM, Recent Recent TOTAL = 2*GJ*REAL(1 - U)Recent = 2*GJ*(1 - REAL(U))Recent ELASTIC = GJ*(1 - U)**2 Recent GJ*((1 - 2*REAL(U)) + (REAL(U)**2 + IM(U)**2))= Recent = 2*GJ*(1 - REAL(U)) - GJ*(1 - (REAL(U)**2 + IM(U)**2))Recent Recent SINCE THE FIRST TERM IS THE TOTAL, THE SECOND TERM MUST BE Recent ABSORPTION. SO WE FIND, Recent Recent $ABSORPTION = GJ^{*}(1 - (REAL(U)^{*2} + IM(U)^{*2}))$ Recent Recent IN ALL CASES U IS DEFINED IN THE FORM, Recent Recent TT = EXP(-I*2*PS)*((1-X) - I*Y)Recent Recent WHERE (X) AND (Y) ARE RELATED TO THE SYMMETRIC AND ANTI-SYMMETRIC Recent CONTRIBUTIONS OF THE RESONANCES, RESPECTIVELY. ONLY THE DEFINITION Recent OF (X) AND (Y) WILL BE DIFFERENT FOR EACH RESONANCE FORMALISM. Recent BELOW WE WILL SHOW THAT WHAT MIGHT APPEAR TO BE A STRANGE CHOICE Recent OF DEFINITION OF THE SIGN OF (X) AND(Y) HAS BEEN SELECTED SO THAT Recent FOR BREIT-WIGNER PARAMETERS (X) AND (Y) CORRESPOND EXACTLY TO THE Recent SYMMETRIC AND ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES. Recent Recent = (COS(2*PS) - I*SIN(2*PS))*((1-X) - I*Y)U Recent ((1-X)*COS(2*PS) - Y*SIN(2*PS))Recent =-I*((1-X)*SIN(2*PS) + Y*COS(2*PS))Recent Recent REAL(U) = ((1-X) * COS(2*PS) - Y*SIN(2*PS))Recent TM(U) =-((1-X)*SIN(2*PS) + Y*COS(2*PS))Recent Recent R(U) **2 = ((1-X) *COS(2*PS)) **2 + (Y*SIN(2*PS)) **2Recent -2*(1-X)*Y*COS(2*PS)*SIN(2*PS) Recent I(U) **2 = ((1-X) *SIN(2*PS)) **2 + (Y*COS(2*PS)) **2Recent +2*(1-X)*Y*COS(2*PS)*SIN(2*PS) Recent Recent

THE TERMS 2*(1-X)*Y*COS(2*PS)*SIN(2*PS) CANCEL AND UPON USING Recent THE IDENTITY $\cos(2*PS)**2 + \sin(2*PS)**2 = 1$, Recent Recent SUM = (1-X) * 2 + (Y) * 2Recent Recent WE NOW HAVE ALL THE QUANTITIES THAT WE NEED TO DEFINE THE CROSS Recent SECTIONS. Recent Recent ELASTIC Recent _____ Recent ELASTIC =GJ*(1 - 2*REAL(U) + (REAL(U)**2 + IM(U)**2))Recent =GJ*(1 - 2*((1-X)*COS(2*PS)-Y*SIN(2*PS))+(1-X)**2+(Y)**2) Recent Recent THIS CAN BE WRITTEN AS A SUM OF 2 SQUARES, Recent Recent ELASTIC =GJ*(COS(2*PS) - (1-X))**2 + (SIN(2*PS) + Y)**2) Recent Recent =GJ*((COS(2*PS))**2 - 2*(1-X)*COS(2*PS) + (1-X)**2) +Recent (SIN(2*PS))**2 + 2*Y*SIN(2*PS)+ (Y)**2) Recent Recent AGAIN USING THE IDENTITY COS(2*PS)**2 + SIN(2*PS)**2 = 1, WE CAN Recent SEE THAT THE DEFINITION AS THE SUM OF 2 SQUARES IS IDENTICAL TO Recent THE PRECEDING DEFINITION OF THE ELASTIC. Recent Recent ELASTIC =GJ*(COS(2*PS) - (1-X))**2 + (SIN(2*PS) + Y)**2)Recent =GJ*((COS(2*PS)-1) + X)**2 + (SIN(2*PS) + Y)**2)Recent Recent USING THE IDENTITY (1 - COS(2*PS))) = 2*SIN(PS)**2, WE OBTAIN Recent THE FINAL FORM FOR THE ELASTIC, Recent Recent ELASTIC =GJ*(2*SIN(PS)*2 - X)*2 + (SIN(2*PS) + Y)*2)Recent Recent ABSORPTION Recent Recent _____ ABSORPTION = GJ*(1 - (REAL(U)**2 + IM(U)**2))Recent = GJ*(1 - ((1-X))*2)+ (Y)**2) Recent $= GJ^{*}(1 - (1 - 2^{*}X + (X)^{*}2 + (Y)^{*}2))$ Recent $= GJ^{*}(2^{*}X - (X)^{*}2 + (Y)^{*}2)$ Recent Recent SINCE PHYSICALLY THE ABSORPTION CANNOT BE NEGATIVE WE CAN SEE Recent THAT (X) MUST BE POSITIVE AND 2*X MUST BE GREATER THAN Recent (X) **2 + (Y) **2, FOR ALL OF THE FORMALISMS. Recent Recent TOTAL Recent ===== Recent IN THIS PROGRAM THE TOTAL CROSS SECTION IS ALWAYS DEFINED TO BE Recent THE SUM OF ITS PARTS - SO THE ABOVE DEFINITION IS NEVER EXPLICITLY Recent USED. HOWEVER, WE CAN LEARN SOMETHING BY EXAMINING THE DEFINITION, Recent Recent TOTAL = 2*GJ*REAL(1 - U)Recent = 2*GJ*(1 - (((1-X)*COS(2*PS) - Y*SIN(2*PS)))Recent = 2*GJ*((1 - COS(2*PS))*(1-X) - (1-X) + Y*SIN(2*PS))Recent = 2*GJ*(2*SIN(PS)**2*(1-X))- (1-X) + Y*SIN(2*PS))Recent Recent = 4*GJ*SIN(PS)**2 +Recent 2*GJ*((X-1) - 2*X*SIN(PS)**2 + Y*SIN(2*PS)) Recent Recent THE IMPORTANT POINT TO NOTE IS THAT THE DEFINITION OF THE TOTAL Recent DOES NOT EXPLICITLY CONTAIN ANY DEPENDENCE ON X**2 AND Y**2 -Recent THE LEVEL-LEVEL INTERFERENCE TERMS. Recent Recent THIS IMPLIES THAT IF A GIVEN SET OF RESONANCE PARAMETERS ARE USED Recent WITH THIS DEFINITION THEY WILL PRODUCE EXACTLY THE SAME TOTAL Recent

CROSS SECTION - WHETHER WE CLAIM THE PARAMETERS HAVE BEEN Recent PRODUCED USING A SINGLE OR MULTI-LEVEL FIT. THIS RESULT COULD Recent BE VERY MISLEADING, IF THIS RESULT FOR THE TOTAL IS IMPLIED TO Recent MEAN THAT ONE INTERPRETATION OR THE OTHER WILL NOT HAVE ANY Recent EFFECT ON THE INDIVIDUAL CROSS SECTIONS. Recent Recent STARTING FROM EXACTLY THE SAME RESONANCE PARAMETERS, RELATIVE TO Recent THE RESULTS OBTAINED USING THE SINGLE LEVEL FORMULA, MULTI-LEVEL Recent RESULTS WILL TEND TO ALWAYS DECREASE THE ABSORPTION AND INCREASE Recent Recent THE ELASTIC. THIS CAN BE IMMEDIATELY SEEN FROM OUR GENERAL MULTI-LEVEL DEFINITION OF ABSORPTION, Recent Recent ABSORPTION = $GJ^*(2^X - ((X)^{*2} + (Y)^{*2}))$ Recent Recent THE SINGLE LEVEL ABSORPTION IS, Recent Recent ABSORPTION =GJ*(2*X) Recent Recent THE DIFFERENCE BETWEEN THE TWO IS -2*GJ*(X**2 + Y**2), SO THAT Recent REGARDLESS OF HOW WE DEFINE (X) AND (Y) THE INCLUSION OF THIS Recent TERM WILL ALWAYS DECREASE ABSORPTION. SINCE THE TOTAL CROSS Recent SECTION IS THE SAME IN BOTH CASE, THIS MEANS THAT THE ELASTIC Recent HAS BEEN INCREASED BY THIS AMOUNT. Recent Recent AGAIN, THESE RESULTS ARE BASED ON STARTING FROM EXACTLY THE SAME Recent PARAMETERS - IN ANY ACTUAL CASE THE PARAMETERS BASED ON A SINGLE Recent OR MULTI-LEVEL FIT WILL BE QUITE DIFFERENT - THE POINT THAT WE Recent WANT TO STRESS HERE IS THAT YOU SHOULD NEVER USE PARAMETERS Recent WHICH HAVE BEEN DEFINED BY A FIT USING ONE FORMALISM - IN THE Recent EQUATIONS FOR A DIFFERENT FORMALISM - AND ASSUME THAT THE RESULTS Recent WILL BE CONSISTENT - AND NEVER USE THE TOTAL CROSS SECTION TO Recent SEE WHETHER OR NOT A SET OF SINGLE LEVEL PARAMETERS CAN BE USED Recent WITH A MULTI-LEVEL FORMALISM. Recent Recent POTENTIAL CROSS SECTION Recent Recent FAR FROM RESONANCES (X) AND (Y) WILL BE SMALL AND THE ELASTIC Recent CROSS SECTION REDUCES TO, Recent Recent ELASTIC =GJ*(2*SIN(PS)**2)**2 + (SIN(2*PS))**2 Recent =GJ*4*(SIN(PS)**4 + SIN(2*PS)**2 Recent Recent USING THE IDENTITY SIN(2*PS) = 2*SIN(PS)*COS(PS) Recent Recent =4*GJ*(SIN(PS)**4+ (SIN(PS)*COS(PS))**2) Recent =4*GJ*SIN(PS)**2*(SIN(PS)**2 + COS(PS)**2)Recent =4*GJ*SIN(PS)**2Recent Recent WHICH IS THE POTENTIAL CROSS SECTION. NOTE THAT THIS RESULT IS Recent INDEPENDENT OF THE FORMALISM USED, AS IT MUST PHYSICALLY BE, Recent AND AS SUCH ALTHOUGH AS YET WE HAVE NOT DEFINED IT, WE CAN Recent NOW SEE THAT IN ALL CASES (PS) MUST BE THE PHASE SHIFT AND FOR Recent CONSISTENCY IT MUST BE DEFINED USING EXACTLY THE SAME DEFINITION Recent IN ALL CASES. Recent Recent IN ADDITION SINCE PHYSICALLY FOR EACH L VALUE WE EXPECT TO OBTAIN Recent A POTENTIAL CROSS SECTION, Recent Recent 4*(2*L+1)*SIN(PS)**2 Recent Recent OBVIOUSLY FOR CONSISTENCY WE MUST HAVE, Recent Recent (2*L+1) = (SUM OVER J) GJRecent

Recent ONLY IN THIS CASE WILL THE RESULTS BE CONSISTENT - THIS POINT WILL Recent BE DISCUSSED IN DETAIL BELOW. Recent Recent WHAT ARE THIS TERMS (X) AND (Y) Recent Recent (X) AND (Y) CAN BE EASILY IDENTIFIED BY CONSIDERING THE SINGLE Recent AND MULTI-LEVEL BREIT WIGNER FORMALISMS. IN THESE CASES WE WILL Recent FIND THAT. Recent Recent х = GAM(N) *GAM(T)/2/DEN Recent = GAM(N) * (E-ER)/DEN Y Recent = ((E-ER)**2 + (GAM(T)/2)**2)DEN Recent Recent EXTREME CARE HAS TO BE USED TO PROPERLY DEFINE (Y) SUCH THAT IT Recent IS NEGATIVE FOR E LESS THAN ER AND POSITIVE FOR E GREATER THAN Recent ER. I WILL MERELY MENTION THAT THE EQUATIONS FOR ALL FORMALISMS Recent IN ENDF-102 DO NOT CONSISTENTLY USE (E - ER) - IN SOME CASES Recent THIS IS WRITTEN AS (ER - E), WHICH CAN LEAD TO AN INCORRECT Recent SIGN IN THE DEFINITION OF THE (Y) THAT WE REQUIRE. Recent Recent THE INTERFERENCE TERMS CAN BE WRITTEN IN TERMS OF, Recent 1) LEVEL-SELF INTERFERENCE = THE CONTRIBUTION OF EACH LEVEL Recent INTERFERRING WITH ITSELF Recent 2) LEVEL-LEVEL INTERFERENCE = THE CONTRIBUTION OF EACH LEVEL Recent INTERFERRRING WITH ALL OTHER LEVELS Recent Recent WE WILL REFER TO THESE TWO AS (L-S) AND (L-L), Recent Recent x**2 = (GAM(N) * (GAM(T)/2) * * 2/(DEN) * * 2+ (L-L) Recent = (GAM(N) * 2*((GAM(T)/2) * 2)/(DEN) * 2 + (L-L))Recent Y**2 = (GAM(N)) **2*((E-ER)) **2/(DEN) **2+ (L-L) Recent Recent X**2+Y**2= GAM(N)**2*DEN/(DEN)**2 = GAM(N)**2/DEN + (L-L) Recent Recent TO SEE THE EFFECT OF INCLUDING MULTI-LEVEL INTERFERENCE WE CAN Recent CONSIDER OUR GENERAL EXPRESSION FOR ABSORPTION, Recent Recent ABSORPTION = $GJ^*(2^X - ((X)^{*2} + (Y)^{*2}))$ Recent Recent AND NOTE THAT FOR BOTH SINGLE AND MULTI-LEVEL BREIT WIGNER THE Recent ENDF-102 SAYS TO TREAT ABSORPTION IN A SINGLE LEVEL APPROXIMATION Recent I.E., IGNORE LEVEL-LEVEL INTERFERENCE. IF ALL INTERFERENCE IS Recent IGNORED THIS IS EQUIVALENT TO COMPLETELY IGNORING X**2 + Y**2 AND Recent DEFINING, Recent Recent ABSORPTION =GJ*2*X Recent =2*GJ*GAM(N)*GAM(T)/DEN Recent Recent WHICH IS INCORRECT - SINCE THIS SEEMS TO INDICATE EVERYTHING IS Recent ABSORBED. IN ORDER TO OBTAIN THE CORRECT EXPRESSION WE CANNOT Recent COMPLETELY IGNORE INTERFERENCE - WE CAN IGNORE LEVEL-LEVEL Recent INTERFERENCE, BUT WE MUST INCLUDE LEVEL-SELF INTERFERENCE, Recent Recent X**2+Y**2= GAM(N)**2/DEN Recent Recent ABSORPTION =GJ*(2*X - ((X)**2 + (Y)**2))Recent =GJ*GAM(N)*(GAM(T)-GAM(N))/DENRecent =GJ*GAM(N)*GAM(A)/DENRecent Recent SUMMARY Recent Recent AN IMPORTANT POINT TO NOTE IS THE DEFINITION OF (X) AND (Y) Recent

WHICH IN ALL CASES WILL CORRESPOND TO THE SYMMETRIC AND Recent ANTI-SYMMETRIC CONTRIBUTION OF THE RESONANCES. IN PARTICULAR Recent DEFINING (U) IN TERMS OF (1-X) INSTEAD OF (X) IS EXTREMELY Recent IMPORTANT. NOTE, THAT THE DEFINITION OF THE ELASTIC AND Recent ABSORPTION ONLY INVOLVE (X), NOT (1-X). FAR FROM RESONANCES Recent (X) CAN BE EXTREMELY SMALL, THEREFORE (1-X) WILL BE VERY CLOSE Recent TO (1). IF THE CALCULATION PROCEEDS BY FIRST CALCULATING (1-X) Recent AND THEN DEFINING (X) BY SUBTRACTING (1), EXTREME ROUND-OFF Recent. PROBLEMS CAN RESULT. THESE PROBLEMS CAN BE AVOIDED BY IN ALL Recent CASES DEFINING (X) DIRECTLY, WITHOUT ANY DIFFERENCES. Recent Recent IN EACH FORMALISM THE DEFINITION OF (X) AND (Y) MAY BE DIFFERENT Recent BUT ONCE WE HAVE DEFINED (X) AND (Y) WE CAN IMMEDIATELY WRITE Recent THE CROSS SECTIONS USING A UNIFORM DEFINITION, Recent Recent ELASTIC =GJ*(2*SIN(PS)**2 - X)**2 + (SIN(2*PS) + Y)**2)Recent Recent ABSORPTION = $-GJ^{*}(2^{*}X + (X)^{*}2 + (Y)^{*}2)$ Recent Recent AND DEFINE THE TOTAL AS THE SUM OF THESE 2 PARTS. Recent Recent RELATIONSHIP TO SINGLE LEVEL Recent Recent HOW DO THE SINGLE AND MULTI-LEVEL FORMALISMS COMPARE. TO SEE, Recent STARTING FROM OUR GENERAL DEFINITION OF THE ELASTIC IN THE FORM, Recent Recent ELASTIC =GJ*(2*SIN(PS)**2 + X)**2 + (SIN(2*PS) + Y)**2) Recent =GJ*(4*SIN(PS)**4 - 4*X*SIN(PS)**2 + X**2 Recent + SIN(2*PS)**2 + 2*Y*SIN(2*PS) + Y**2)Recent Recent =4*GJ*SIN(PS)**2 + Recent GJ*(X**2 + Y**2 Recent -4*X*SIN(PS)**2 Recent +2*Y*SIN(2*PS)) Recent Recent AND OUR SPECIFIC DEFINITIONS OF (X) AND (Y) FOR MULTI-LEVEL BREIT- Recent WIGNER PARAMETERS, Recent Recent. х = GAM(N) *GAM(T)/2/DEN Recent Y = GAM(N) * (E-ER)/DEN Recent = ((E-ER)**2 + (GAM(T)/2)**2)DEN Recent Recent X**2+Y**2= GAM(N)**2/DEN + (L-L) Recent Recent WE CAN RECOGNIZE X**2 AND Y**2 AS THE INTERFERENCE - (L-S) + (L-L) Recent TERMS IN THE MULTI-LEVEL FORMALISM. IN ORDER TO OBTAIN THE SINGLE Recent LEVEL EQUATION WE CAN ASSUME THAT EACH LEVEL DOES NOT INTERFERE Recent WITH ANY OTHER LEVEL - THEREFORE THE (L-L) CONTRIBUTION IS ZERO. Recent Recent ELASTIC =4*GJ*SIN(PS)**2 + Recent GJ*GAM(N)*(GAM(N))Recent -2*GAM(T)*SIN(PS)**2 Recent +2*(E-ER)*SIN(2*PS))/DEN Recent Recent WHICH IS THE FORM THAT IT APPEARS IN ENDF-102, EXCEPT FOR TWO Recent TYPOGRAPHICAL ERRORS IN THE SECOND TERM, Recent Recent -2*GAM(T)*SIN(PS)**2 Recent Recent WHICH IN ENDF-102 IS WRITTEN, Recent Recent -2*(GAM(T)-GAM(N))*SIN(2*PS)**2 Recent Recent

	Recent				
MINIMUM INPUT DATA					
	Recent				
FOR EACH MATERIAL TO BE PROCESSED THE MINIMUM INPUT DATA ARE THE	Recent				
RESONANCE PARAMETERS IN FILE 2. IF THERE ARE NO FILE 2 PARAMETERS					
IN A GIVEN MATERIAL THE ENTIRE MATERIAL WILL SIMPLY BE COPIED.					
NEITHER THE HOLLERITH SECTION (MF=1, MT=451) NOR THE BACKGROUND					
CROSS SECTION (SECTIONS OF MF=3) NEED BE PRESENT FOR THIS PROGRAM	Recent				
TO EXECUTE PROPERLY. HOWEVER, SINCE THE CONVENTIONS USED IN	Recent				
INTERPRETING THE RESONANCE PARAMETERS DEPENDS ON ENDF/B VERSION	Recent				
USERS ARE STRONGLY RECOMMENDED TO INSURE THAT MF=1, MT=451 IS	Recent				
PRESENT IN EACH MATERIAL TO ALLOW THE PROGRAM TO DETERMINE THE	Recent				
ENDF/B FORMAT VERSION.	Recent				
	Recent				
RESONANCE PARAMETERS	Recent				
	Recent				
RESONANCE PARAMETERS MAY BE REPRESENTED USING ANY COMBINATION OF THE REPRESENTATIONS ALLOWED IN ENDF/B,	Recent Recent				
(1) RESOLVED DATA	Recent				
(1) RESOLVED DATA (A) SINGLE LEVEL BREIT-WIGNER	Recent				
(B) MULTI-LEVEL BREIT-WIGNER	Recent				
(C) ADLER-ADLER	Recent				
(D) REICH-MOORE	Recent				
(E) HYBRID R-FUNCTION	Recent				
(2) UNRESOLVED DATA	Recent				
(A) ALL PARAMETERS ENERGY INDEPENDENT	Recent				
(B) FISSION PARAMETERS ENERGY DEPENDENT	Recent				
(C) ALL PARAMETERS ENERGY DEPENDENT	Recent				
	Recent				
THE FOLLOWING RESOLVED DATA FORMALISMS ARE NOT TREATED BY THIS	Recent				
VERSION OF THE CODE AND WILL ONLY BE IMPLEMENTED AFTER EVALUATIONS	Recent				
USING THESE FORMALISMS ARE AVAILABLE TO THE AUTHOR OF THIS CODE	Recent				
FOR TESTING IN ORDER TO INSURE THAT THEY CAN BE HANDLED PROPERLY	Recent				
(A) GENERAL R-MATRIX	Recent				
	Recent				
CALCULATED CROSS SECTIONS	Recent				
	Recent				
THIS PROGRAM WILL USE THE RESONANCE PARAMETERS TO CALCULATE THE	Recent				
TOTAL, ELASTIC, CAPTURE AND POSSIBLY FISSION CROSS SECTIONS. THE	Recent				
COMPETITIVE WIDTH WILL BE USED IN THESE CALCULATIONS, BUT THE	Recent Recent				
	Recent				
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE					
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED	Recent				
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED	Recent Recent				
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED AS A SECTION OF FILE 3 DATA.	Recent Recent Recent				
ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED AS A SECTION OF FILE 3 DATA. RESOLVED REGION	Recent Recent Recent Recent				
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COMPETITIVE CROSS SECTION ITSELF WILL NOT BE CALCULATED. THE ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED AS A SECTION OF FILE 3 DATA. RESOLVED REGION 	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent				
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ENDF/B CONVENTION IS THAT ALTHOUGH A COMPETITIVE WIDTH MAY BE GIVEN, THE COMPETITIVE CROSS SECTION MUST BE SEPARATELY TABULATED AS A SECTION OF FILE 3 DATA. RESOLVED REGION 	Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent Recent				

200 - INTERPOLATION REGIONS Recent 500 - TABULATED VALUES Recent IF THESE LIMITS ARE EXCEEDED THE PROGRAM WILL PRINT AN ERROR Recent MESSAGE AND TERMINATE. Recent Recent IF YOU REQUIRE A LARGER NUMBER OF INTERPOLATION REGION AND/OR Recent TABULATED VALUES, Recent (1) INTERPOLATION REGIONS - INCREASE THE DIMENSION OF NBTRHO AND Recent INTRHO IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE MAXSEC Recent IN SUBROUTINE RDAP (MAXSEC = MAXIMUM NUMBER OF INTERPOLATION Recent REGIONS). Recent (2) TABULATED VALUES - INCREASE THE DIMENSION OF ERHOTB, RHOTAB Recent AND APTAB IN COMMON/TABRHO/ THROUGHOUT THE PROGRAM AND CHANGE Recent MAXRHO IN SUBROUTINE RDAP (MAXRHO = MAXIMUM NUMBER OF TABULATED Recent VALUES). Recent Recent RESOLVED REICH-MOORE AND MULTI-LEVEL BREIT-WIGNER PARAMETERS Recent _____ Recent CROSS SECTIONS FOR REICH-MOORE PARAMETERS ARE CALCULATED ACCORDING Recent TO THE EQUATION (1) - (8) OF SECTION D.1.3 OF ENDF-102. IN ORDER Recent TO CALCULATE CROSS SECTIONS FROM MULTI-LEVEL PARAMETERS IN A Recent REASONABLE AMOUNT OF TIME THIS PROGRAM EXPRESSES THE CROSS SECTION Recent IN TERMS OF A SINGLE SUM OVER RESONANCES (SEE, ENDF-102, SECTION Recent D.1.2, EQUATIONS 6-7), RATHER THAN AS A DOUBLE SUM (SEE, ENDF-102 Recent SECTION D.1.2, EQUATION 1-2). IN ORDER FOR THE ENDF-102 EQUATIONS Recent TO BE CORRECT THE PARAMETERS MUST MEET THE FOLLOWING CONDITIONS, Recent Recent (1) FOR EACH L STATE ALL PHYSICALLY POSSIBLE J SEQUENCES MUST BE Recent PRESENT. ONLY IN THIS CASE WILL THE CONTRIBUTIONS OF THE Recent INDIVIDUAL J SEQUENCES ADD UP TO PRODUCE THE CORRECT POTENTIAL Recent SCATTERING CONTRIBUTION FOR THE L STATE (SEE, ENDF-102, Recent SECTION D.1.2, EQUATIONS 6-7). IF ANY J SEQUENCE IS MISSING Recent THE PROGRAM WILL PRINT A WARNING AND ADD THE J SEQUENCE WITH Recent NO RESONANCE PARAMETERS IN ORDER TO ALLOW THE POTENTIAL Recent SCATTERING TO BE CALCULATED CORRECTLY (THIS IS EQUIVALENT TO Recent ASSUMING THAT THE EVALUATOR REALIZES THAT ALL J SEQUENCES MUST Recent BE AND ARE PRESENT AND THAT THE EVALUATION STATES THAT THERE Recent ARE NO RESONANCES WITH CERTAIN PHYSICALLY POSSIBLE J VALUES... Recent IN THIS CASE POTENTIAL CONTRIBUTION MUST STILL BE CONSIDERED). Recent Recent EXAMPLE Recent Recent AN EXAMPLE OF WHERE THIS OCCURS AND IS IMPORTANT TO CONSIDER Recent IS U-238 IN ENDF/B-IV AND V LIBRARIES WHERE FOR L=1 THERE IS Recent ONLY A J=1/2 SEQUENCE. NOT INCLUDING THE J=3/2 SEQUENCE LEADS Recent TO UNDERESTIMATING THE POTENTIAL SCATTERING AND PRODUCES Recent MINIMA IN THE ELASTIC CROSS SECTION WHICH ARE AN ORDER OF Recent MAGNITUDE LOWER THAN THE CROSS SECTIONS OBTAINED BE INCLUDING Recent THE J=3/2 SEQUENCE. Recent Recent. (2) FOR A GIVEN TARGET SPIN AND L VALUE THERE MAY BE 2 POSSIBLE Recent MEANS OF OBTAINING THE SAME J VALUE. WHEN THIS OCCURS IN Recent ORDER TO CALCULATE THE CORRECT POTENTIAL SCATTERING CROSS Recent SECTION IT IS IMPORTANT TO INCLUDE THE EFFECT OF BOTH Recent POSSIBLE J SEQUENCES, EVEN THOUGH FROM THE ENDF/B DATA IT IS Recent NOT POSSIBLE TO DETERMINE WHICH OF THE 2 POSSIBLE SEQUENCES Recent ANY GIVEN RESONANCE BELONGS TO. IN THIS CASE THIS PROGRAM Recent TREAT ALL RESONANCES WITH THE SAME J VALUE AS BELONGING TO Recent THE SAME J SEQUENCE (TO ALLOW INTERFERENCE) AND WILL ADD AN Recent ADDITIONAL J SEQUENCE WITH NO RESONANCES IN ORDER TO ALLOW Recent THE POTENTIAL CROSS SECTION TO BE CALCULATED CORRECTLY. WHEN Recent THIS OCCURS A WARNING MESSAGE IS PRINTED, BUT BASED ON THE Recent ENDF/B DATA THERE IS NOTHING WRONG WITH THE DATA AND THERE IS Recent

NOTHING THAT THE USER CAN DO TO CORRECT OR IN ANY WAY MODIFY Recent THE DATA TO ELIMINATE THE PROBLEM. Recent

EXAMPLE

FOR A TARGET SPIN =1 AND L=1 THE 2 RANGES OF PHYSICALLY POSSIBLE J ARE 1/2, 3/2, 5/2 AND 1/2, 3/2. BY CHECKING THE ENDF/B DATA IT IS POSSIBLE TO INSURE THAT THE 3 POSSIBLE J VALUES (1/2, 3/2, 5/2) ARE PRESENT AND TO INCLUDE ALL 3 J SEQUENCES IN THE CALCULATIONS. HOWEVER, UNLESS ALL 5 POSSIBLE J SEQUENCES ARE INCLUDED THE STATISTICAL WEIGHTS OF THE J SEQUENCES WILL NOT SUM UP TO 2*L+1 AND THE POTENTIAL CROSS SECTION WILL BE UNDERESTIMATED. IN THIS EXAMPLE THE SUM OF THE 3 J SEQUENCES 1/2, 3/2, 5/2 IS 2, RATHER THAN 3 AS IT SHOULD BE FOR L=1, AND THE CONTRIBUTION OF THE L=1 RESONANCES TO THE POTENTIAL SCATTERING CROSS SECTION WILL ONLY BE 2/3 OF WHAT IT SHOULD BE, UNLESS THE OTHER 2 J SEQUENCES (WITH DUPLICATE J VALUES) ARE INCLUDED IN THE CALCULATION.

(3) EACH RESONANCE MUST HAVE AN ASSIGNED, PHYSICALLY POSSIBLE Recent J VALUE. PHYSICALLY IMPOSSIBLE OR AVERAGE J VALUES CANNOT BE UNIQUELY INTERPRETED USING THE EQUATIONS IN ENDF-102 AND Recent THEIR USE WILL USUALLY RESULT IN PHYSICALLY UNRELIABLE CROSS SECTIONS. THIS PROGRAM WILL CHECK ALL J VALUES AND IF ANY ARE ARE FOUND TO BE PHYSICALLY IMPOSSIBLE (BASED ON TARGET SPIN Recent AND L VALUE) AN ERROR MESSAGE WILL BE PRINTED TO INDICATE THAT Recent THE RECONSTRUCTED CROSS SECTIONS WILL BE UNRELIABLE AND THE RECENT POTENTIAL SCATTERING CROSS SECTION THIS PROGRAM WILL SUBTRACT THE POTENTIAL SCATTERING CONTRIBUTION DUE TO ALL FICTICIOUS J Recent SEQUENCES AND ADD THE CONTRIBUTION OF ALL PHYSICALLY POSSIBLE J SEQUENCES (AS DESCRIBED ABOVE).

WARNING (LET THE USER BEWARE)

- (A) IT CANNOT BE STRESSED ENOUGH THAT CROSS SECTIONS OBTAINED Recent USING PHYSICALLY IMPOSSIBLE J VALUES FOR REICH-MOORE AND Recent MULTI-LEVEL BREIT-WIGNER RESONANCE PARAMETERS WILL RESULT Recent IN UNRELIABLE CROSS SECTIONS. THE DECISION TO HAVE THIS Recent PROGRAM CONTINUE TO PROCESS WHEN THIS CONDITION IS FOUND Recent IS BASED ON AN ATTEMPT TO ALLOW THE USER TO AT LEAST HAVE Recent SOME RESULTS (HOWEVER BAD THEY MAY BE) IF THERE IS NO Recent OTHER EVALUATED DATA AVAILABLE.
- (B) EVEN THOUGH THE REICH-MOORE AND MULTI-LEVEL EQUATIONS ARE Recent DEFINED AS ABSOLUTE OR SQUARED CONTRIBUTIONS WHICH MUST Recent ALL BE PHYSICALLY POSSIBLE, ATTEMPTING TO CORRECT THE Recent POTENTIAL CROSS SECTION (AS DESCRIBED ABOVE) CAN LEAD TO Recent NEGATIVE ELASTIC CROSS SECTIONS. THIS IS BECAUSE BASED ON Recent THE INFORMATION AVAILABLE IN THE EVALUATION IT IS NOT Recent NOT POSSIBLE TO CORRECTLY ACCOUNT FOR THE INTERFERENCE Recent BETWEEN THE RESONANCE AND POTENTIAL CONTRIBUTIONS FOR EACH Recent J SEQUENCE. Recent

UNRESOLVED RESONANCE REGION

IN THE UNRESOLVED RESONANCE REGION THE UNRESOLVED PARAMETERS Recent ARE USED TO CALCULATE INFINITELY DILUTE AVERAGE CROSS SECTIONS. Recent NOTE, IT IS IMPORTANT TO UNDERSTAND THAT FROM THE DEFINITION OF Recent THE UNRESOLVED PARAMETERS IT IS NOT POSSIBLE TO UNIQUELY CALCULATE Recent ENERGY DEPENDENT CROSS SECTIONS. ONLY AVERAGES OR DISTRIBUTIONS Recent MAY BE CALCULATED. Recent

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Recent UNRESOLVED INTERPOLATION _____ Recent IN THE UNRESOLVED RESONANCE REGION CROSS SECTIONS AT EACH ENERGY Recent ARE CALCULATED BY INTERPOLATING PARAMETERS. THIS IS THE CONVENTION Recent USED IN ENDF/B-IV AND EARLIER VERSIONS OF ENDF/B. THE ENDF/B-V Recent CONVENTION OF INTERPOLATING CROSS SECTIONS, NOT PARAMETERS, HAS Recent BEEN ABANDONED AS IMPRACTICAL SINCE IT CAN LEAD TO THE SITUATION Recent WHERE EXACTLY THE SAME PHYSICAL DATA CAN LEAD TO DIFFERENT RESULTS Recent DEPENDING ON WHICH OF THE THREE ENDF/B UNRESOLVED PARAMTER FORMATS Recent IS USED. FOR EXAMPLE, GIVEN A SET OF ENERGY INDEPENDENT UNRESOLVED Recent PARAMETERS IT IS POSSIBLE TO CODE THESE PARAMETERS IN EACH OF THE Recent THREE ENDF/B UNRESOLVED PARAMETER FORMATS. SINCE PHYSICALLY WE Recent ONLY HAVE ONE SET OF PARAMETERS WE WOULD EXPECT THE RESULTS TO BE Recent INDEPENDENT OF HOW THEY ARE REPRESENTED IN ENDF/B. UNFORTUNATELY Recent USING THE ENDF/B-V CONVENTION TO INTERPOLATE CROSS SECTIONS CAN Recent LEAD TO THREE COMPLETELY DIFFERENT RESULTS. IN CONTRAST USING THE Recent ENDF/B-IV AND EARLIER CONVENTION OF INTERPOLATING PARAMETERS LEADS Recent TO COMPLETELY CONSISTENT RESULTS. Recent Recent INTERNAL REPRESENTATION OF UNRESOLVED PARAMETERS Recent _____ Recent ANY OF THE THREE POSSIBLE REPRESENTATIONS OF UNRESOLVED PARAMETERS Recent CAN BE UNIQUELY REPRESENTED IN THE ALL PARAMETERS ENERGY DEPENDENT Recent REPRESENTATIONS WITH THE APPROPRIATE (ENDF/B VERSION DEPENDENT) Recent INTERPOLATION LAW. THIS IS DONE BY THE PROGRAM WHILE READING THE Recent UNRESOLVED PARAMETERS AND ALL SUBSEQUENT CALCULATIONS NEED ONLY Recent CONSIDER THE ALL PARAMETERS ENERGY DEPENDENT REPRESENTATION. Recent Recent RESONANCE RECONSTRUCTION STARTING ENERGY GRID Recent Recent AS IN ANY ITERATIVE METHOD THE WAY TO SPEED CONVERGENCE IS TO TRY Recent TO START CLOSE TO THE ANSWER. THIS PROGRAM ATTEMPTS TO DO THIS BY Recent STARTING FROM AN ENERGY GRID WHICH IS A GOOD APPROXIMATION TO A Recent SIMPLE BREIT-WIGNER LINE SHAPE, Recent Recent. SIGMA(X) = 1.0/(1.0+X*X)Recent Recent WHERE X IS THE DISTANCE FROM THE PEAK IN HALF-WIDTHS Recent. Recent SUBROUTINE SUBINT HAS A BUILT-IN TABLE OF NODES WHICH ARE THE Recent HALF-WIDTH MULTIPLES TO APPROXIMATE THE SIMPLE BREIT-LINE SHAPE Recent TO WITHIN 1 PER-CENT OVER THE ENTIRE INTERVAL 0 TO 500 HALF-WIDTHS Recent Recent BETWEEN ANY TWO RESOLVED RESONANCES THE STARTING GRID IS BASED ON Recent THE HALF-WIDTHS OF THE TWO RESONANCES. FROM THE LOWER ENERGY Recent RESONANCE UP TO THE MID-POINT BETWEEN THE RESONANCES (MID-POINT Recent IS DEFINED HERE AS AN EQUAL NUMBER OF HALF-WIDTHS FROM EACH Recent RESONANCE) THE HALF-WIDTH OF THE LOWER ENERGY RESONANCE IS USED. Recent FROM THE MID-POINT UP TO THE HIGHER ENERGY RESONANCE THE HALF-Recent WIDTH OF THE UPPER ENERGY RESONANCE IS USED. Recent Recent WITH THIS ALOGORITHM CLOSELY SPACED RESONANCES WILL HAVE ONLY Recent A FEW STARTING NODES PER RESONANCE (E.G. U-235). WIDELY SPACED Recent RESONANCES WILL HAVE MORE NODES PER RESONANCE (E.G. U-238). FOR Recent A MIX OF S, P, D ETC. RESONANCES THIS ALOGORITHM GUARANTEES AN Recent ADEQUTE DESCRIPTION OF THE PROFILE OF EVEN EXTREMELY NARROW Recent RESONANCES (WHICH MAY IMMEDIATELY CONVERGENCE TO THE ACCURACY Recent REQUESTED, THUS MINIMIZING ITERATION). Recent Recent BACKGROUND CROSS SECTIONS Recent ------Recent THE PROGRAM WILL SEARCH FOR BACKGROUND CROSS SECTIONS FOR TOTAL Recent (MT=1), ELASTIC (MT=2), FISSION (MT=18), FIRST CHANCE FISSION Recent

(MT=19) AND CAPTURE (MT=102). Recent Recent (1) THE BACKGROUND CROSS SECTIONS (FILE 3) CAN BE PRESENT OR NOT Recent PRESENT FOR EACH REACTION. Recent (2) IF FOR A GIVEN REACTION THE BACKGROUND CROSS SECTION IS Recent PRESENT, IT WILL BE ADDED TO THE RESONANCE CONTRIBUTION AND Recent THE RESULT WILL BE OUTPUT. Recent (3) IF FOR A GIVEN REACTION THE BACKGROUND IS NOT PRESENT THE Recent PROGRAM WILL, Recent (A) IF THE INPUT TO THE PROGRAM SPECIFIES NO OUTPUT FOR Recent REACTIONS WITH NO BACKGROUND THERE WILL BE NO OUTPUT. Recent (B) IF THE INPUT TO THE PROGRAM SPECIFIES OUTPUT FOR REACTIONS Recent WITH NO BACKGROUND, Recent (I) THE RESONANCE CONTRIBUTION TO TOTAL, ELASTIC OR Recent CAPTURE WILL BE OUTPUT. Recent (II) IF ALL FISSION RESONANCE PARAMETERS ARE ZERO THE Recent FISSION CROSS SECTION (MT=18) WILL NOT BE OUTPUT. Recent OTHERWISE THE RESONANCE CONTRIBUTION OF THE FISSION Recent (MT=18) WILL BE OUTPUT. Recent (III) THERE WILL BE NO OUTPUT FOR FIRST CHANCE FISSION Recent (MT=19). Recent Recent COMBINING RESONANCES AND BACKGROUND CROSS SECTIONS Recent Recent IN ORDER TO BE COMBINED WITH THE RESONANCE CONTRIBUTION THE Recent BACKGROUND CROSS SECTIONS MUST BE GIVEN AT 0 KELVIN TEMPERATURE Recent AND MUST BE LINEARLY INTERPOLABLE. IF THESE CONDITIONS ARE MET Recent THE RESONANCE AND BACKGROUND CONTRIBUTIONS WILL BE ADDED TOGETHER Recent AND OUTPUT. IF THESE CONDITIONS ARE NOT MET THE BACKGROUND CROSS Recent SECTION WILL BE IGNORED AND ONLY THE RESONANCE CONTRIBUTION WILL Recent BE OUTPUT. IF THE BACKGROUND HAS NOT BEEN ADDED TO THE RESONANCE Recent CONTRIBUTION AFTER THIS PROGRAM FINISHES THE USER CAN MAKE THE Recent RESONANCE AND BACKGROUND CONTRIBUTIONS COMPATIBLE BY, Recent Recent (1) IF THE BACKGROUND IS NOT LINEARLY INTERPOABLE, LINEARIZE THE Recent BACKGROUND (E.G., USE PROGRAM LINEAR). Recent (2) IF THE BACKGROUND IS NOT GIVEN AT 0 KELVIN, DOPPLER BROADEN Recent THE RESONANCE (NOT BACKGROUND) CONTRIBUTION TO THE SAME Recent TEMPERATURE AS THE BACKGROUND (E.G., USE PROGRAM SIGMA1). Recent Recent ONCE THE RESONANCE AND BACKGROUND CONTRIBUTIONS HAVE BEEN MADE Recent COMPATIBLE THEY CAN BE ADDED TOGETHER (E.G., USE PROGRAM MIXER). Recent Recent THE RECONSTRUCTION OF THE RESONANCE CONTRIBUTION TO THE CROSS Recent SECTION CAN BE QUITE EXPENSIVE (IN TERMS OF COMPUTER TIME). SINCE Recent THE RECONSTRUCTION IS PERFORMED BEFORE THE BACKGROUND CROSS Recent SECTIONS ARE READ, THE ABOVE CONVENTIONS HAVE BEEN ADOPTED IN Recent ORDER TO AVOID LOSE OF COMPUTER TIME INVOLVED IN RECONSTRUCTING Recent THE RESONANCE CONTRIBUTION. Recent Recent COMMON ENERGY GRID Recent _____ Recent THIS PROGRAM WILL RECONSTRUCT THE RESONANCE CONTRIBUTION TO THE Recent TOTAL, ELASTIC, FISSION AND CAPTURE CROSS SECTIONS ALL ON THE Recent SAME ENERGY GRID. EACH REACTION WILL THEN BE COMBINED WITH ITS Recent BACKGROUND CROSS SECTION (IF ANY) AND OUTPUT WITHOUT ANY FURTHER Recent THINNING. IF THERE ARE NO BACKGROUND CROSS SECTIONS, OR IF THE Recent BACKGROUND CROSS SECTION FOR ALL FOUR REACTIONS ARE GIVEN ON A Recent COMMON ENERGY GRID, THE OUTPUT FROM THIS PROGRAM WILL BE ON A Recent COMMON ENERGY GRID FOR ALL FOUR REACTIONS. Recent Recent THERMAL ENERGY Recent Recent _____

IF THE RESONANCE REGION SPANS THERMAL ENERGY (0.0253 EV) THIS Recent POINT IS ALWAYS INCLUDED IN THE COMMON ENERGY GRID USED FOR ALL Recent REACTIONS AND WILL ALWAYS APPEAR IN THE OUTPUT DATA. Recent Recent SECTION SIZE Recent Recent SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT Recent TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS Recent SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. Recent Recent SELECTION OF DATA Recent _____ Recent THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON Recent MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR Recent ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE Recent ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS Recent USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA Recent IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS. Recent Recent ALLOWABLE ERROR Recent _____ Recent THE RECONSTRUCTION OF LINEARLY INTERPOLABLE CROSS SECTIONS FROM Recent RESONANCE PARAMETERS CANNOT BE PERFORMED EXACTLY. HOWEVER IT CAN Recent BE PERFORMED TO VIRTUALLY ANY REQUIRED ACCURACY AND MOST Recent IMPORTANTLY CAN BE PERFORMED TO A TOLERANCE THAT IS SMALL COMPARED Recent TO THE UNCERTAINTY IN THE CROSS SECTIONS THEMSELVES. AS SUCH THE Recent CONVERSION OF CROSS SECTIONS TO LINEARLY INTERPOLABLE FORM CAN BE Recent PERFORMED WITH ESSENTIALLY NO LOSS OF INFORMATION. Recent Recent THE ALLOWABLE ERROR MAY BE ENERGY INDEPENDENT (CONSTANT) OR ENERGY Recent DEPENDENT. THE ALLOWABLE ERROR IS DESCRIBED BY A TABULATED Recent FUNCTION OF UP TO 20 (ENERGY, ERROR) PAIRS AND LINEAR INTERPOLATION Recent BETWEEN TABULATED POINTS. IF ONLY ONE TABULATED POINT IS GIVEN THE Recent ERROR WILL BE CONSIDERED CONSTANT OVER THE ENTIRE ENERGY RANGE. Recent WITH THIS ENERGY DEPENDENT ERROR ONE MAY OPTIMIZE THE OUTPUT FOR Recent ANY GIVEN APPLICATION BY USING A SMALL ERROR IN THE ENERGY RANGE Recent OF INTEREST AND A LESS STRINGENT ERROR IN OTHER ENERGY RANGES, Recent E.G., 0.1 PER-CENT FROM 0 UP TO THE LOW EV RANGE AND A LESS Recent STRINGENT TOLERANCE AT HIGHER ENERGIES. Recent Recent DEFAULT ALLOWABLE ERROR Recent -------Recent IN ORDER TO INSURE CONVERENCE OF THE RESONANCE RECONSTRUCTION THE Recent ALLOWABLE ERROR MUST BE POSITIVE. IF THE USER INPUTS AN ERROR FOR Recent RESONANCE RECONSTRUCTION THAT IS NOT POSITIVE IT WILL BE SET TO Recent THE DEFAULT VALUE (CURRENTLY 0.1 PER-CENT) AND INDICATED AS SUCH Recent IN THE OUTPUT LISTING. Recent Recent INTERVAL HALVING ALGORITHM Recent -------Recent THIS PROGRAM WILL START BY CALCULATING THE CROSS SECTIONS AT THE Recent ENERGIES CORRESPONDING TO THE PEAK OF EACH RESONANCE, AS WELL AS Recent A FIXED NUMBER OF HALF-WIDTHS ON EACH SIDE OF EACH RESONANCE. Recent STARTING FROM THIS BASIC GRID OF POINTS THE PROGRAM WILL CONTINUE Recent TO HALF EACH INTERVAL UNTIL THE CROSS SECTIONS FOR ALL REACTIONS Recent AT THE CENTER OF THE INTERVAL CAN BE DEFINED BY LINEAR Recent INTERPOLATION FROM THE ENDS OF THE INTERVAL TO WITHIN THE USER Recent SPECIFIED ACCURACY CRITERIA. Recent Recent DISTANT RESONANCE TREATMENT Recent Recent THE OPTION TO TREAT DISTANT RESONANCES, WHICH WAS AVAILABLE IN Recent EARLIER VERSIONS OF THIS PROGRAM, IS NO LONGER AVAILABLE, BECAUSE Recent

IT WAS FOUND TO PRODUCE UNRELIABLE RESULTS. IN THIS VERSION OF Recent THE PROGRAM ALL RESONANCES ARE TREATED EXACTLY. Recent Recent PROGRAM OPERATION Recent erent EDIT MODE Recent Recent _____ IT IS SUGGESTED THAT BEFORE RUNNING THIS PROGRAM TO RECONSTRUCT Recent CROSS SECTIONS FROM RESONANCE PARAMETERS (WHICH CAN BE QUITE Recent EXPENSIVE) THE USER FIRST RUN THE PROGRAM IN THE EDIT MODE (SEE, Recent DESCRIPTION OF INPUT PARAMETERS BELOW). IN THE EDIT MODE THE Recent PROGRAM WILL READ, LIST AND EXTENSIVELY CHECK THE CONSISTENCY OF Recent ALL RESONANCE PARAMETERS AND ENDF/B DEFINED RESONANCE FLAGS. THIS Recent IS A VERY INEXPENSIVE MEANS OF CHECKING ALL DATA BEFORE INVESTING Recent A LARGE AMOUNT OF MONEY IN RECONSTRUCTING CROSS SECTIONS. ANY AND Recent ALL DIGNOSTICS RECEIVED FROM THE EDIT WILL SUGGEST HOW TO CORRECT Recent THE EVALUATED DATA TO MAKE IT CONSISTENT BEFORE RECONSTRUCTING Recent CROSS SECTIONS. IN ORDER TO OBTAIN MEANINGFUL RESULTS FROM THE Recent RECONSTRUCTION ALL SUGGESTED CHANGES TO THE EVALUATION SHOULD BE Recent PERFORMED BEFORE TRYING RECONSTRUCTION (OTHERWISE THE RESULT OF Recent RECONSTRUCTION WILL NOT BE RELIABLE). Recent Recent RECONSTRUCTION MODE Recent _____ Recent FOR EACH REQUESTED MATERIAL Recent Recent IF SECTION MF=1, MT=451 IS PRESENT COMMENTS WILL BE ADD TO Recent DOCUMENT THAT THE MATERIAL HAS BEEN PROCESSED. MF=1, MT=451 WILL Recent ALSO BE USED TO DETERMINE THE VERSION OF THE ENDF/B FORMAT WHICH Recent WILL ALLOW THE PROGRAM TO USE THE APPROPRIATE CONVENTIONS. Recent Recent ALL OF THE FILE 2 RESONANCE PARAMETERS ARE FIRST READ AND THE Recent LINEARLY INTERPOLABLE CONTRIBUTION OF THE RESONANCE PARAMETERS Recent TO THE TOTAL, ELASTIC, CAPTURE AND FISSION CROSS SECTIONS IS Recent CALCULATED SIMULTANEOUSLY USING A COMMON ENERGY GRID FOR ALL Recent FOUR REACTIONS. Recent Recent AFTER THE RESONANCE CONTRIBUTION HAS BEEN RECONSTRUCTED EACH OF Recent THE FIVE REACTIONS (MT=1, 2, 18, 19, 102) IS CONSIDERED SEPARATELY Recent FOR COMBINATION WILL THE BACKGROUND CROSS SECTION, IF ANY, AS Recent DESCRIBED ABOVE. Recent Recent OUTPUT WILL INCLUDE THE ENTIRE EVALUATION, INCLUDING RESONANCES Recent PARAMETERS WITH LRU MODIFIED (AS DESCRIBED ABOVE) TO INDICATE Recent THAT THE RESONANCE CONTRIBUTION HAS ALREADY BEEN ADDED TO THE Recent FILE 3 CROSS SECTIONS. Recent Recent THE CYCLE OF RECONSTRUCTING THE RESONANCE CONTRIBUTION AND ADDING Recent THE BACKGROUND WILL BE REPEATED FOR EACH MATERIAL REQUESTED. Recent Recent ----2016/3/10 - This option is no longer allowed - today's computers Recent are so mjuch faster that this option is no longer Recent needed. Recent PROCESS ONLY A PORTION OF RESONANCE REGION Recent = Recent MODERN EVALUATIONS MAY BE EXTREMELY LARGE AND IT MAY NOT BE Recent POSSIBLE TO PROCESS AN ENTIRE EVALUATION (I.E., ADD THE RESONANCE Recent CONTRIBUTION) DURING A SINGLE COMPUTER RUN. Recent Recent ALSO IN THE CASE WHERE YOU ARE ONLY INTERESTED IN THE CROSS Recent SECTIONS OVER A SMALL ENERGY RANGE, YOU MAY NOT WANT TO PROCESS Recent AN ENTIRE EVALUATION, E.G., IF YOU ONLY WANT TO KNOW WHAT THE Recent CROSS SECTIONS ARE NEAR THERMAL ENERGY, 0.0253 EV. Recent

Recent. IN ORDER TO ALLOW AN EVALUATION TO BE PROCESSED USING A NUMBER OF Recent SHORTER COMPUTER RUNS AN OPTION HAS BEEN ADDED TO THIS PROGRAM TO Recent ALLOW THE USER TO SPECIFY THE ENERGY RANGE TO BE PROCESSED. Recent Recent USING THIS OPTION YOU MAY START AT THE LOWEST ENERGY (ZERO UP TO Recent SOME ENERGY) AND USE THE RESULTS OF THIS RUN AS INPUT TO THE Recent NEXT RUN, WHERE YOU CAN SPECIFY THE NEXT ENERGY RANGE. THIS Recent CYCLE CAN BE REPEATED UNTIL YOU HAVE PROCESSED THE ENTIRE Recent EVALUATION. Recent Recent WARNING - THIS OPTION SHOULD BE USED WITH EXTREME CARE - THIS Recent OPTION HAS BEEN RELUCTANTLY ADDED - RELUCTANTLY BECAUSE IT CAN Recent BE EXTREMELY DANGEROUS TO USE THIS OPTION UNLESS YOU CAREFULLY Recent CHECKED WHAT YOU ARE DOING. Recent Recent THE OPTION SHOULD ONLY BE USED AS FOLLOWS, Recent 1) YOU MUST PROCESS USING ENERGY RANGES STARTING AT LOW ENERGY Recent AND WORKING YOUR WAY TOWARD HIGH ENERGY, E.G., Recent 0.0 TO 3.0+3 Recent 3.0+3 TO 10.0+3 Recent 10.0+3 TO 80.0+3, ETC. Recent 2) FOR THE LAST ENERGY RANGE THE LOWER ENERGY LIMIT MUST BE Recent NON-ZERO (WHERE TO START) AND THE UPPER ENERGY LIMIT MUST Recent BE ZERO (NO LIMIT) Recent 80.0+3 TO 0.0 Recent Recent IF YOU ARE ONLY INTERESTED IN THE CROSS SECTION OVER A NARROW Recent ENERGY INTERVAL AND DO NOT INTENT TO MAKE ANY OTHER USE OF THE Recent RESULTS, YOU CAN IGNORE THESE WARNINGS AND MERELY SPECIFY ANY Recent ENERGY INTERVAL OVER WHICH YOU WISH CALCULATIONS TO BE Recent PERFORMED. Recent Recent NORMALLY WHEN THIS PROGRAM PROCESSES AN EVALUATION IT WILL SET Recent FLAGS IN THE EVALUATION TO PREVENT THE SAME RESONANCE Recent CONTRIBUTION FROM BEING ADDED TO THE CROSS SECTION MORE THAN Recent ONCE, SHOULD YOU USE THE OUTPUT FROM THIS PROGRAM AS INPUT TO Recent THE PROGRAM. Recent Recent WHEN PROCESSING ONLY PORTIONS OF THE RESONANCE REGION THIS Recent PROGRAM CANNOT SET THESE FLAGS TO PROTECT AGAINST ADDING THE Recent RESONANCE CONTRIBUTION MORE THAN ONCE - WHICH MAKES USE OF Recent THIS OPTION EXTREMELY DANGEROUS. Recent Recent ONLY YOU CAN CHECK TO MAKE SURE THAT YOU HAVE CORRECTLY Recent INCLUDED EACH ENERGY RANGE ONLY ONCE - SEE THE COMMENT LINES Recent AT THE END OF SECTION, MF=1, MT=451, FOR A COMPLETE RECORD Recent OF EACH RUN USING THIS PROGRAM. THIS SECTION WILL CONTAIN Recent LINES OF THE FORM Recent Recent Recent ONLY PROCESS 0.00000+ 0 TO 3.00000+ 3 EV Recent Recent ONLY PROCESS 3.00000+ 3 TO 1.00000+ 4 EV Recent Recent ONLY PROCESS 1.00000+ 4 TO 8.00000+ 4 EV Recent Recent ONLY PROCESS 8.00000+ 4 TO 2.00000+ 7 EV Recent Recent YOU SHOULD CHECK TO INSURE THAT THERE ARE NO OVERLAPPING ENERGY Recent RANGES OR MISSING ENERGY RANGES. Recent Recent WHEN YOU INDICATE BY INPUT THAT YOU ARE ABOUT TO PROCESS THE Recent

LAST ENERGY RANGE (SEE ABOVE, LOWER ENERGY LIMIT = NON-ZERO, Recent UPPER ENERGY LIMIT = ZERO), THIS PROGRAM WILL ASSUME THAT Recent YOU HAVE NOW COMPLETED ALL PROCESSING - AND ONLY THEN WILL Recent IT SET FLAGS IN THE EVALUATION TO PREVENT THE RESONANCE Recent CONTRIBUTION FROM BEING ADDED MORE THAN ONCE. FOR THIS REASON Recent YOU CANNOT PROCESS STARTING WITH ENERGY INTERVALS AT HIGH Recent ENERGY AND WORKING TOWARD LOW ENERGY - YOU MUST START AT LOW Recent ENERGY AND WORK TOWARD HIGH ENERGY. Recent ----2016/3/10 - This option is no longer allowed - today's computers Recent Recent I/O FILES Recent ______ Recent INPUT FILES Recent _____ Recent UNIT DESCRIPTION Recent _____ Recent 2 INPUT LINE (BCD - 80 CHARACTERS/RECORD) Recent 10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) Recent Recent OUTPUT FILES Recent _____ Recent UNIT DESCRIPTION Recent _____ Recent 3 OUTPUT REPORT (BCD - 120 CHARACTERS/RECORD) Recent 11 FINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) Recent Recent SCRATCH FILES Recent Recent UNIT DESCRIPTION Recent ____ Recent SCRATCH FILE FOR DATA RECONSTRUCTED FROM RESONANCE 12 Recent PARAMETERS (BINARY - 100200 WORDS/RECORD) Recent 14 SCRATCH FILE FOR COMBINED FILE 2 AND 3 DATA Recent (BINARY - 40080 WORDS/RECORD) Recent Recent OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINE FILEIO) Recent ----- Recent UNIT FILE NAME Recent _____ ____ Recent 2 RECENT. INP Recent RECENT.LST 3 Recent 10 ENDFB.IN Recent 11 ENDFB.OUT Recent 12 (SCRATCH) Recent 14 (SCRATCH) Recent Recent INPUT CARDS Recent ______ Recent LINE COLS. FORMAT DESCRIPTION Recent ----- -----Recent ----1 1-11 I11 RETRIEVAL CRITERIA (0=MAT, 1=ZA) Recent THIS OPTION DEFINED WHETHER COLUMNS 1-22 OF Recent SUBSEQUENT INPUT CARDS SHOULD BE INTERPRETED Recent TO BE MAT OR ZA RANGES. Recent E11.4 FILE 2 MINIMUM ABSOLUTE CROSS SECTION 12-22 Recent (IF 1.0E-10 OR LESS IS INPUT THE PROGRAM Recent WILL USE 1.0E-10) Recent 23-33 I11 TREATMENT OF REACTIONS FOR WHICH BACKGROUND Recent CROSS SECTION IS NOT GIVEN. Recent = 0 - IGNOR (I.E. NO OUTPUT)Recent = 1 - OUTPUT RESONANCE CONTRIBUTION. Recent THIS OPTION IS USEFUL WITH PARTIAL EVALUATION Recent (E.G. ENDF/B-V DOSIMETRY LIBRARY) WHERE ONLY Recent

			ONE OF MORE OF THE PERCENCE ARE OF ACTIVAT	Decent
			ONE OR MORE OF THE REACTIONS ARE OF ACTUAL INTEREST.	Recent
			WARNINGTHE USE OF THIS FIELD HAS BEEN	Recent Recent
				Recent
			DEFINE THE PRECISION OF THE CALCULATION AND	Recent
			OUTPUT. THE FORMER DEFINITION OF THIS FIELD	Recent
			WAS	Recent
			MINIMUM ENERGY SPACING FLAG	Recent
			= 0 - 6 DIGIT MINIMUM ENERGY SPACING.	Recent
			STANDARD 6 DIGIT E11.4 OUTPUT.	Recent
			= 1 - 9 DIGIT MINIMUM ENERGY SPACING.	Recent
			STANDARD 6 DIGIT E11.4 OUTPUT.	Recent
			= 2 - 9 DIGIT MINIMUM ENERGY SPACING.	Recent
			VARIABLE 9 DIGIT F FORMAT OUTPUT.	Recent
			FROM EXPERIENCE IT HAS BEEN FOUND THAT	Recent
			FAILURE TO SET THIS OPTION TO 2 CAN RESULT	
			IN LARGE ERRORS IN THE FINAL DATA. THEREFORE	
			INTERNALLY THIS OPTION IS SET TO 2.	Recent
	34-44	I11	OPERATING MODE	Recent
			= 0 - CACULATE. MINIMUM OUTPUT LISTING	Recent
			= 1 - CACULATE. LIST ALL RESONANCE PARAMETERS	
				Recent
			RESONANCE PARAMETERS.	Recent
			, , , , ,	Recent Recent
			EVALUATED DATA, BEFORE RECONSTRUCTING CROSS	
			SECTIONS (SEE, COMMENTS ABOVE).	Recent
	45-55	I11	NEGATIVE CROSS SECTIOIN TREATMENT	Recent
			= 0 - 0.K NO CHANGE	Recent
			= 1 - SET = 0	Recent
	56-66	I11	MONITOR MODE SELECTOR	Recent
			= 0 - NORMAL OPERATION	Recent
			= 1 - MONITOR PROGRESS OF RECONSTRUCTION OF	Recent
			FILE 2 DATA AND COMBINING FILE 2 AND	Recent
			FILE 3 DATA. EACH TIME A PAGE OF DATA	Recent
			POINTS IS WRITTEN TO A SCRATCH FILE	Recent
			PRINT OUT THE TOTAL NUMBER OF POINTS	Recent
			ON SCRATCH AND THE LOWER AND UPPER	Recent
			ENERGY LIMITS OF THE PAGE (THIS OPTION	
			MAY BE USED IN ORDER TO MONITOR THE	Recent
0	1 70		EXECUTION SPEED OF LONG RUNNING JOBS).	
2	1-/2	A/Z	ENDF/B INPUT DATA FILENAME	Recent
3	1-72	A72	(STANDARD OPTION = ENDFB.IN) ENDF/B OUTPUT DATA FILENAME	Recent
3	T-12	A/2	(STANDARD OPTION = ENDFB.OUT)	Recent Recent
4-N	1-11	I11	MINIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1)	Recent
	12-22	I11	MAXIMUM MAT OR ZA (SEE COLS. 1-11, LINE 1)	Recent
		-	UP TO 100 MAT OR ZA RANGES MAY BE SPECIFIED,	Recent
			ONE RANGE PER LINE. THE LIST IS TERMINATED	Recent
			BY A BLANK LINE. IF THE THE UPPER LIMIT OF	Recent
			ANY REQUEST IS LESS THAN THE LOWER LIMIT THE	Recent
			UPPER LIMIT WILL BE SET EQUAL TO THE LOWER	Recent
			LIMIT. IF THE FIRST REQUEST LINE IS BLANK IT	Recent
			WILL TERMINATE THE REQUEST LIST AND CAUSE ALL	
	101-5	_	DATA TO BE RETRIEVED (SEE EXAMPLE INPUT).	Recent
2016	/3/10 -		Processing no longer allowed.	Recent
			e fields are not blank the code will STOP	Recent
	23-22		WARNING that this is no longer allowed. LOWER ENERGY LIMIT FOR PROCESSING.	Recent
	23-33 34-44	E11.4 E11 4	UPPER ENERGY LIMIT FOR PROCESSING.	Recent Recent
	54 44		*THE LOWER AND UPPER ENERGY LIMITS MUST BE	Recent
			ZERO, OR BLANK, UNLESS YOU WISH TO ONLY	Recent
			PROCESS A PORTION OF RESONANCE REGIONS.	Recent

*THESE ENERGY LIMITS ARE ONLY READ FROM THE Recent FIRST MAT/ZA REQUEST LINE Recent *IF BOTH ARE ZERO (OR BLANK) THE ENTIRE Recent RESONANCE REGION FOR EACH MATERIAL WILL BE Recent PROCESSED Recent *IF LIMITS ARE INPUT ONLY THAT PORTION OF THE Recent RESONANCE REGION FOR EACH MATERIAL WHICH Recent LIES BETWEEN THESE LIMITS WILL BE PROCESSED Recent *SEE INSTRUCTIONS ABOVE BEFORE USING THIS Recent OPTION. Recent ----- 2016/3/10 - Partial Processing no longer allowed. Recent E11.4 ENERGY FOR FILE 2 ERROR LAW VARY 1-11 (SEE) Recent E11.4 ERROR FOR FILE 2 ERROR LAW 12 - 22(COMMENTS) Recent (BELOW) Recent Recent NOTE, THIS VERSION OF THE PROGRAM DOES NOT THIN THE COMBINED FILE Recent FILE 2 + 3 DATA. AS SUCH THE ERROR LAW FOR COMBINING FILE 2 + 3 Recent WHICH WAS REQUIRED IN EARLIER VERSIONS OF THIS CODE ARE NO LONGER Recent REQUIRED. Recent Recent. THE FILE 2 ERROR LAW MAY BE ENERGY INDEPENDENT (DEFINED BY A Recent SINGLE ERROR) OR ENERGY DEPENDENT (DEFINED BY UP TO 20 ENERGY, Recent ERROR PAIRS). FOR THE ENERGY DEPENDENT CASE LINEAR INTERPOLATION Recent WILL BE USED TO DEFINE THE ERROR AT ENERGIES BETWEEN THOSE AT Recent WHICH THE ERROR IS TABULATED. THE ERROR LAW IS TERMINATED BY A Recent BLANK LINE. IF ONLY ONE ENERGY, ERROR PAIR IS GIVEN THE LAW WILL Recent BE CONSIDERED TO BE ENERGY INDEPENDENT. IF MORE THAN ONE PAIR Recent IS GIVEN IT BE CONSIDERED TO BE ENERGY DEPENDENT (NOTE, THAT Recent FOR A CONSTANT ERROR THE ENERGY INDEPENDENT FORM WILL RUN FASTER. Recent HOWEVER, FOR SPECIFIC APPLICATIONS AN ENERGY DEPENDENT ERROR MAY Recent BY USED TO MAKE THE PROGRAM RUN CONSIDERABLE FASTER). Recent Recent ALL ENERGIES MUST BE IN ASCENDING ENERGY ORDER. FOR CONVERGENCE Recent OF THE FILE 2 RECONSTRUCTION ALGORITHM ALL THE ERRORS MUST BE Recent POSITIVE. IF ERROR IS NOT POSITIVE IT WILL BE SET EQUAL TO THE Recent STANDARD OPTION (CURRENTLY 0.001, CORRRESPONDING TO 0.1 PER-CENT). Recent IF THE FIRST LINE OF THE ERROR LAW IS BLANK IT WILL TERMINATE THE Recent ERROR LAW AND THE ERROR WILL BE TREATED AS ENERGY INDEPENDENT, Recent. EQUAL TO THE STANDARD OPTION (CURRENTLY, 0.1 PER-CENT). SEE, Recent EXAMPLE INPUT 4. Recent Recent EXAMPLE INPUT NO. 1 Recent. ------Recent CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTIONS Recent WHICH ARE LARGER THAN 1.0E-8 BARNS IN ABSOLUTE VALUE. ONLY OUTPUT Recent REACTIONS FOR WHICH A BACKGROUND IS GIVEN. LIST ALL PARAMETERS AND Recent CALCULATE CROSS SECTIONS. MONITOR THE EXECUTION PROGRESS OF THE Recent PROGRAM. BETWEEN 0 AND 100 EV USE 0.1 PER-CENT ACCURACY. BETWEEN Recent 100 EV AND 1 KEV VARY THE ACCURACY FROM 0.1 TO 1 PER-CENT. ABOVE Recent 1 KEV USE 1 PER-CENT ACCURACY. Recent Recent EXPLICITLY SPECIFY THE STANDARD FILENAMES. Recent Recent THE FOLLOWING 11 INPUT CARDS ARE REQUIRED. Recent Recent 1 1.00000-08 0 1 0 1 Recent ENDFB.IN Recent ENDFB.OUT Recent 92000 92999 Recent 90232 (UPPER LIMIT AUTOMATICALLY SET TO 90232) Recent (END REQUEST LIST) Recent 0.00000+ 0 1.00000-03 Recent 1.00000+02 1.00000-03 Recent.

	0000+03 1.00000-02					Recent		
1.00	0000+09 1.00000-02		_			Recent		
		(END FILE	2 ERROR LA	W)		Recent		
						Recent		
	EXAMPLE INPUT NO. 2					Recent Recent		
	CONSIDER ALL URANIUM ISOTOPES AND TH-232. CONSIDER CROSS SECTION							
	WHICH ARE LARGER THAN					Recent		
	REACTIONS FOR WHICH A					Recent		
	CALCULATED, BUT PARAME							
	PROGRAM WILL NOT BE MC					Recent		
	ENERGIES. SINCE 0.1 PE		-		THE ERROR	Recent Recent		
	LEAVE THE DEETNITION (MEC DIANK		M WTTT	Recent		
	LEAVE THE DEFINITION C THEN USE THE STANDARD		MES BLANK	- THE PROGRA	M WILL	Recent		
	THEN USE THE STANDARD	FILENAMES.				Recent Recent		
	THE FOLLOWING 7 INPUT					Recent		
	THE FOLLOWING / INPOT	CARDS ARE RE	QUIKED.			Recent		
	1 1.00000-08	0	0	0	0	Recent		
	1 1:00000-08	0	0	U	0	Recent		
						Recent		
	92000 92999					Recent		
	90232	(TIPPER T.TM	ידיי אווייסאא	ICALLY SET T	0 90232)	Recent		
	50252	(END REQUE			0 902327	Recent		
		• -	•	FOR ERROR L	AW)	Recent		
		(****				Recent		
	EXAMPLE INPUT NO. 3					Recent		
						Recent		
	THE SAME AS EXAMPLE IN	IPUT NO. 2, C	NLY IN THI	S CASE ONLY	CALCULATE	Recent		
	CROSS SECTIONS OVER TH					Recent		
	THERMAL ENERGY RANGE.					Recent		
	PARAMETERS IN THIS CAS					Recent		
	SECOND INPUT LINE WE H					Recent		
	USE \PREPRO94\LINEAR\E	NDFB.OUT AS	INPUT AND	ENDFB.OUT AS	OUTPUT -	Recent		
	SINCE ENDFB.OUT IS THE	STANDARD OU	TPUT FILEN	AME THE NAME	CAN BE	Recent		
	EITHER INCLUDED IN THE	INPUT OR LE	FT BLANK.			Recent		
						Recent		
	THE FOLLOWING 7 INPUT	CARDS ARE RE	QUIRED.			Recent		
						Recent		
	1 1.00000-08	0	0	0	0	Recent		
\PRI	PRO94\LINEAR\ENDFB.OU1	2				Recent		
ENDI	B.OUT					Recent		
	92000 92999 1.00	000- 2 1.000	00- 1			Recent		
	90232	(UPPER LIM	IIT AUTOMAT	ICALLY SET T	0 90232)	Recent		
		(END REQUE				Recent		
		(USE STAND	ARD OPTION	FOR ERROR L	AW)	Recent		
						Recent		
	EXAMPLE INPUT NO. 4					Recent		
						Recent		
	RECONSTRUCT ALL DATA.					Recent		
	OR NOT THERE IS A BACK					Recent		
	PROGRESS OF THE PROGRA				PER-CENT	Recent		
	ACCURACY. USE \ENDFB6	• •		UT AND		Recent		
	\ENDFB6\RECENT\ZA09223	S AS OUTPUT.				Recent		
						Recent		
	THE FOLLOWING 6 INPUT	CARDS ARE RE	YOTKED.			Recent		
	0.0.0	1	0	0	0	Recent		
\	0 0.0 DFB6\ZA092238	1	0	0	0	Recent		
	DFB6\ZAU92238 DFB6\RECENT\ZA092238					Recent		
12141		RIEVE ALL DA	ידם הואם ביים			Recent Recent		
	1.00000- 2			ZOROI HIDI)		Recent		
	1.00000- 2							

	(END FILE 2 ERF	OR LAW)			Recent
EXAMPLE INPUT NO.	5				Recent Recent Recent
RECONSTRUCT ALL DA	- דא הווסידות הוויסידות	PEACTIONS E	OP WHICH A B	CKCROUND	
CROSS SECTION IS G					
RECONSTRUCT CROSS					
AS INPUT AND ENDEB			CONACI. ODE I	MDID.IN	Recent
					Recent
THIS CORRESPONDS T	O LISTNG ALL OF	THE STANDARD	OPTONS BUTL	-ТN ТО	Recent
THE PROGRAM AND AL		-		10 10	Recent
THE FROGRAM AND AL	L INFOI CARDO R	AI DE DEANN.			Recent
IN THIS CASE THE F	OT.T.OWING 5 INPT	T CARDS ARE	RECUTRED		Recent
(ZEROES ARE INDICA			-	DICATE	Recent
WHERE THE LINE IS.		,	,		
		01 1111 0111	22 001112122		Recent
0 0.0	0	0	0	0	Recent
	(USE STANDARD I	NPUT FTLENAM	IE = ENDER IN	•	Recent
	(USE STANDARD C		•		Recent
	(RETRIEVE ALL D				Recent
	(0.1 ERROR, END		•		Recent
	(Liuton, Lin				Recent
					Necenc