Option 3
Large LOCA-LOOP Separation

Thermal – Hydraulic Benchmarking
BWROG Option 3 Committee

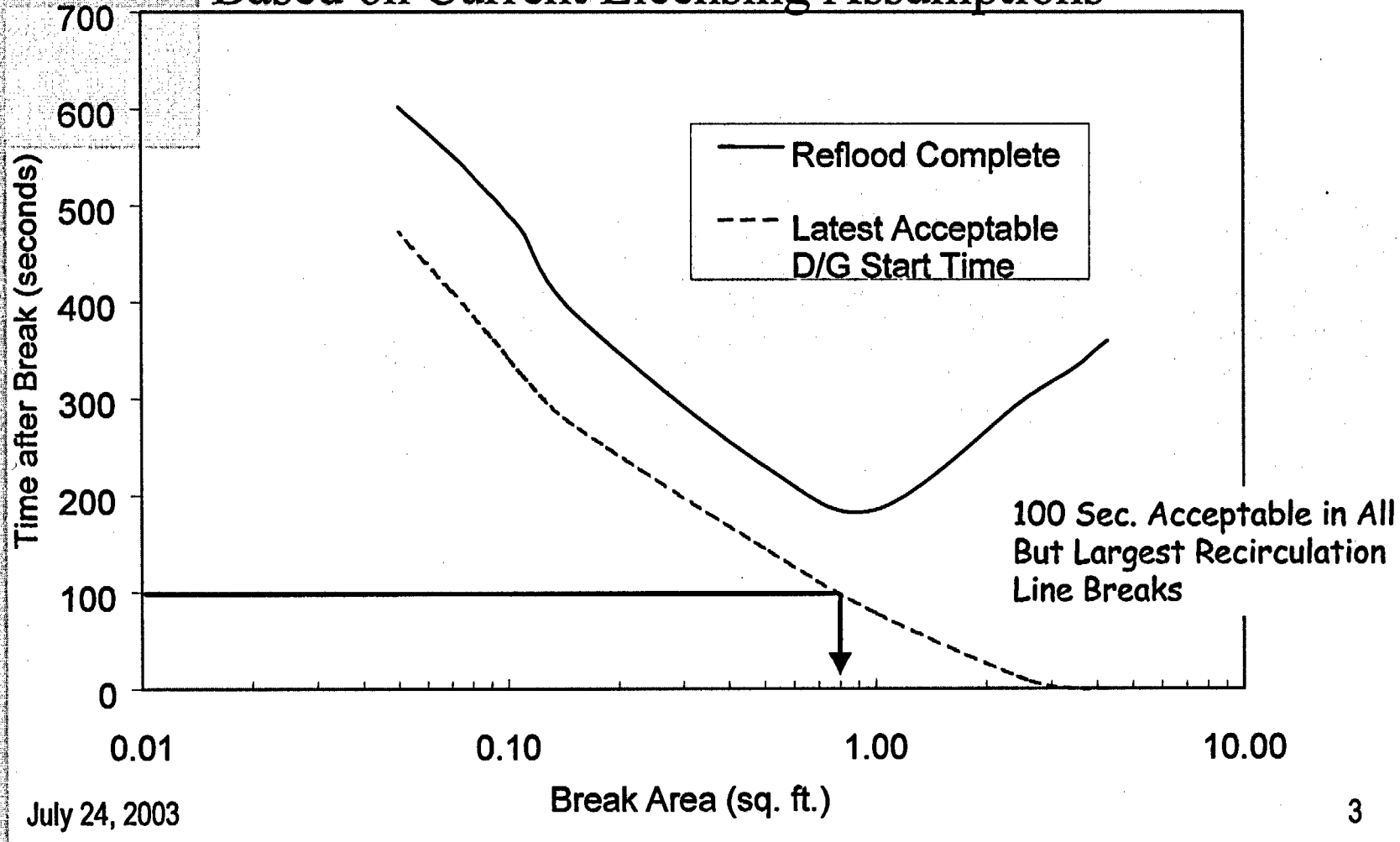
July 24, 2003

Why Are Analyses Needed?

- Demonstrate Success for Smaller Breaks
- Demonstrate Success for LBLOCA with Offsite Power Available
- Demonstrate Defense-In-Depth for LBLOCA with Offsite Power Unavailable

Previous Work Presented to NRC

Based on Current Licensing Assumptions



Non-LOOP and Small Break LOCA Analyses

- Mainly for Licensee Assurance
  - Demonstrate Feasibility
- Implementing Plants May Need to Revise Licensing Basis Calculations
  - Unless Existing Calculations are Bounding

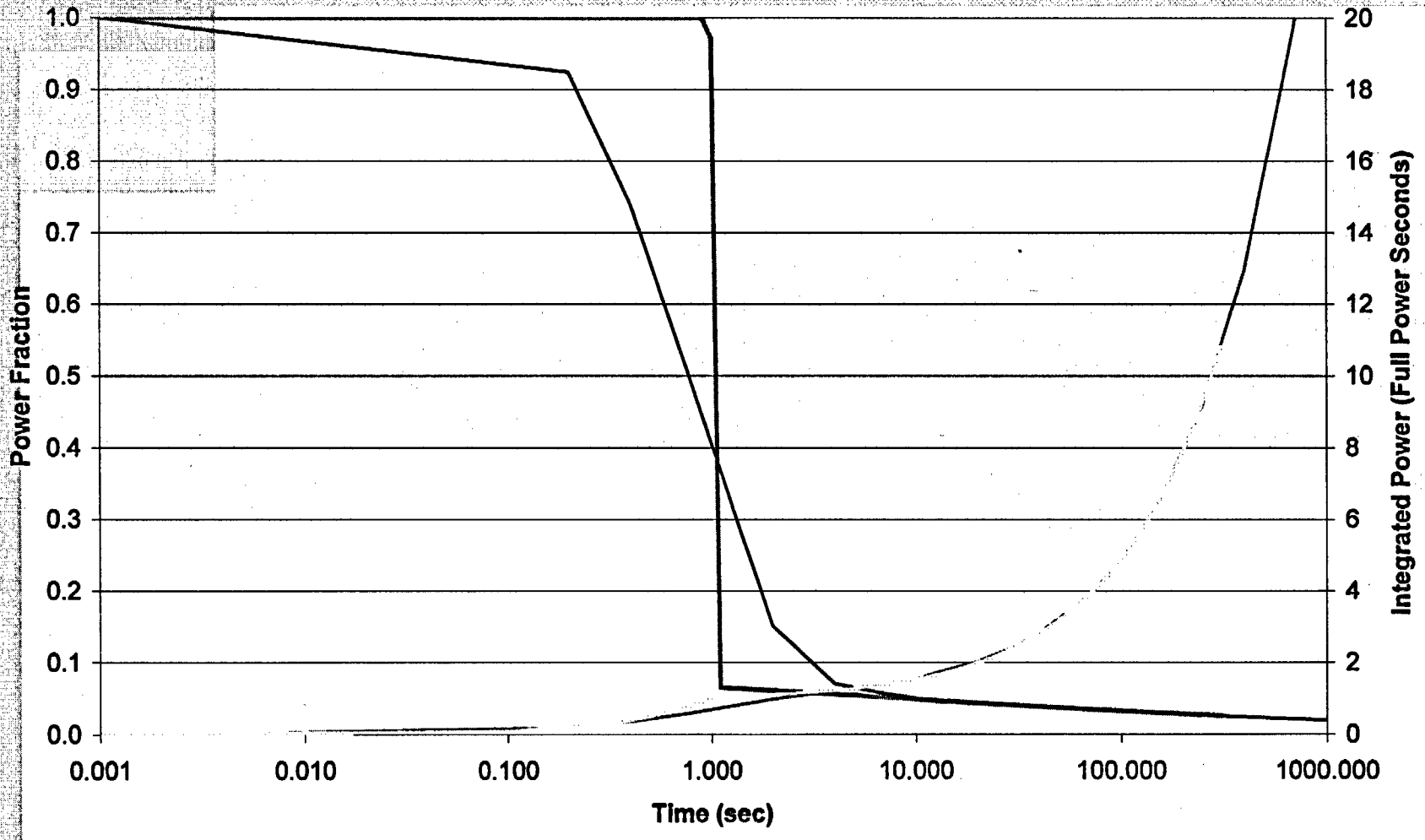
BWROG Approach for LOOP – LBLOCA Analyses

- Benchmark MAAP Model to TRACG & SAFER Results
- Use MAAP to Identify the Cases for Detailed Study
- Determine Confirmatory Cases
  - Use TRACG Results for Base Cases
  - Use MAAP4 Results for Sensitivities

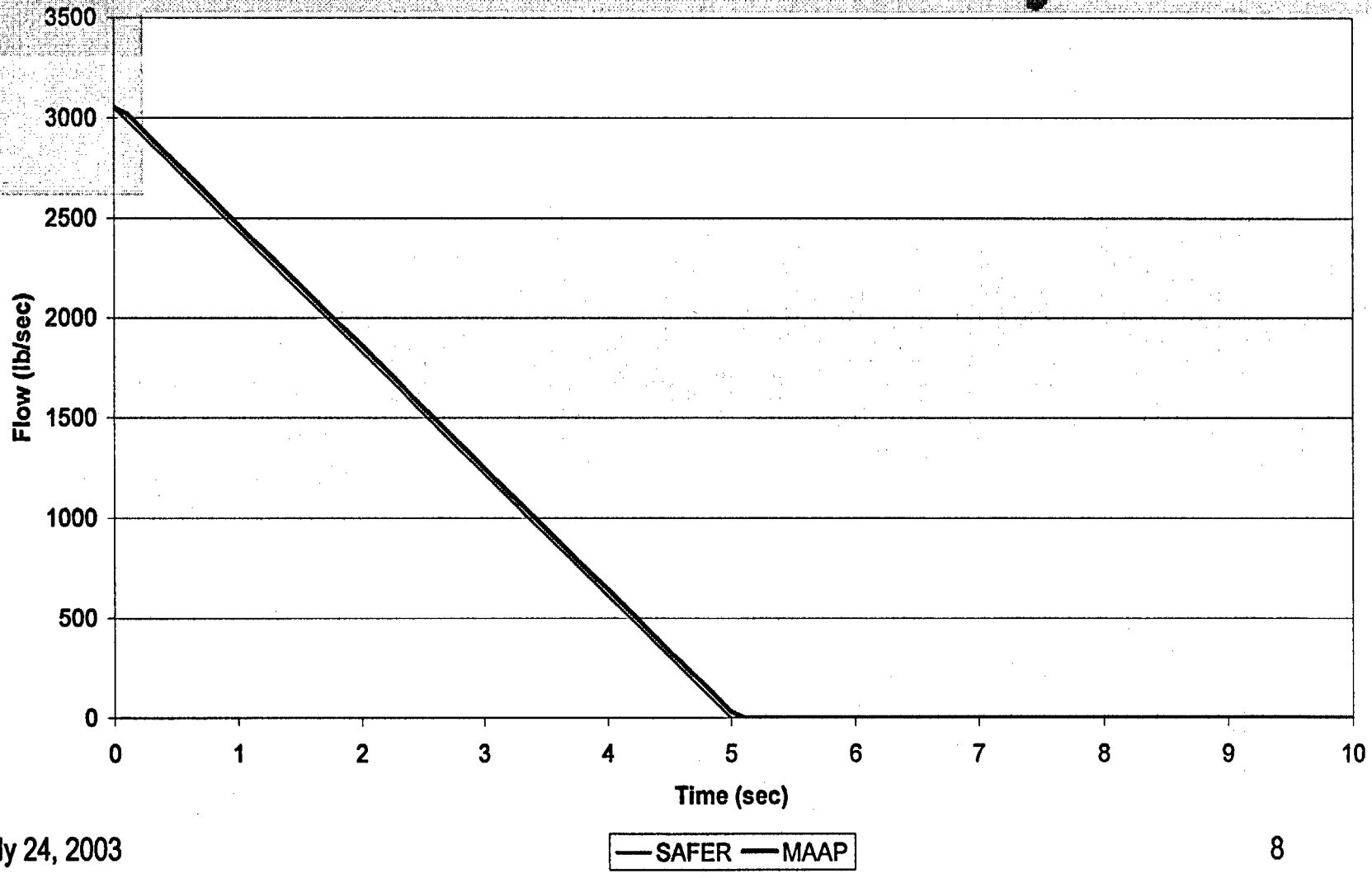
Benchmark

- Based on Existing TRACG & SAFER Benchmarking Analyses
- Peak Clad Temperature (PCT) is the Figure of Merit
- Plant is an Existing BWR 4
- Fuel is GE-14

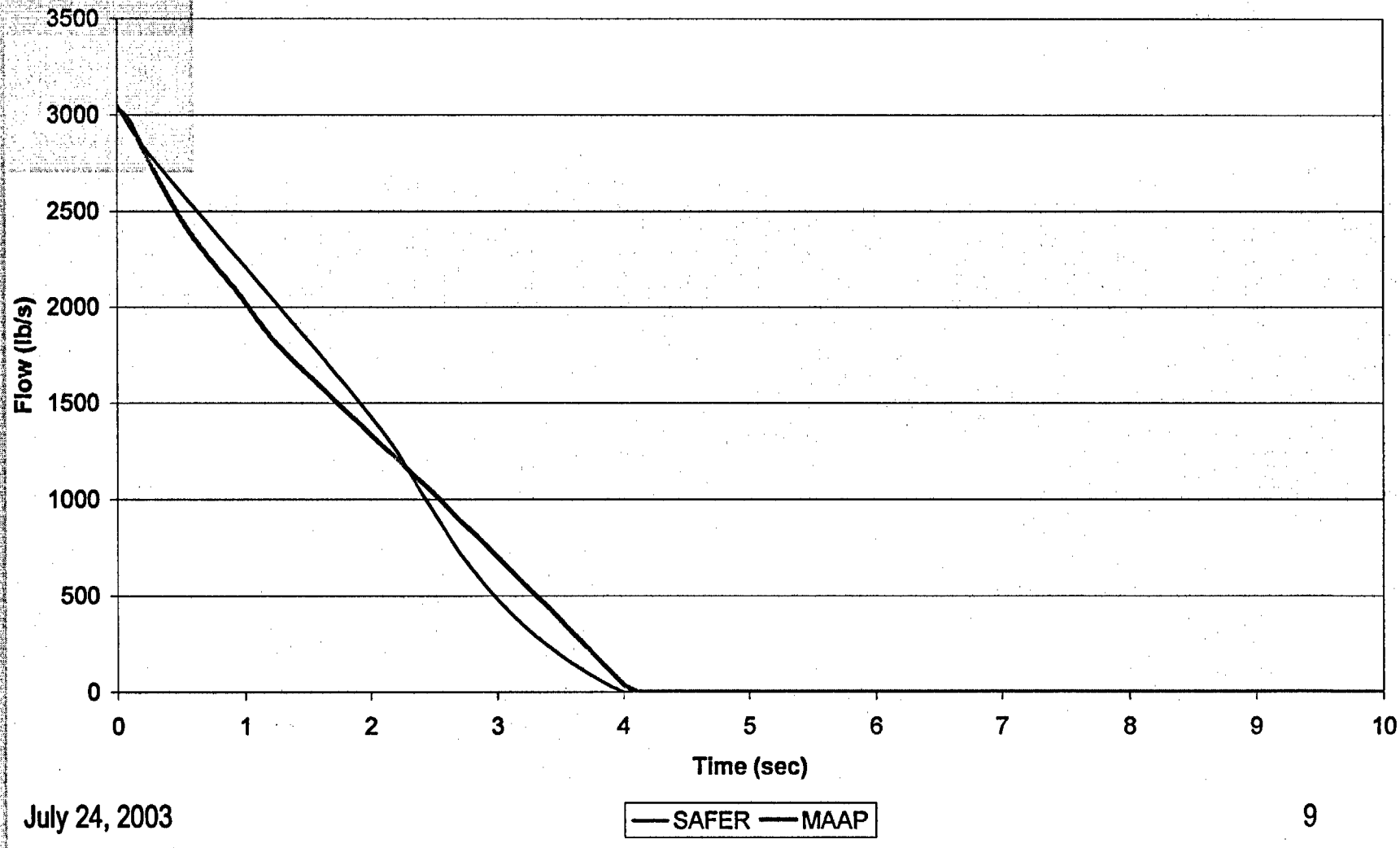
Decay Heat


Power Fraction
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Integrated Power (Full Power Seconds)
20
18
16
14
12
10
8
6
4
2
0
0.001
0.010
0.100
1.000
10.000
100.000
1000.000
Time (sec)
TRAC,SAFER
MAAP
TRAC,SAFER Integrated
MAAP Integrated

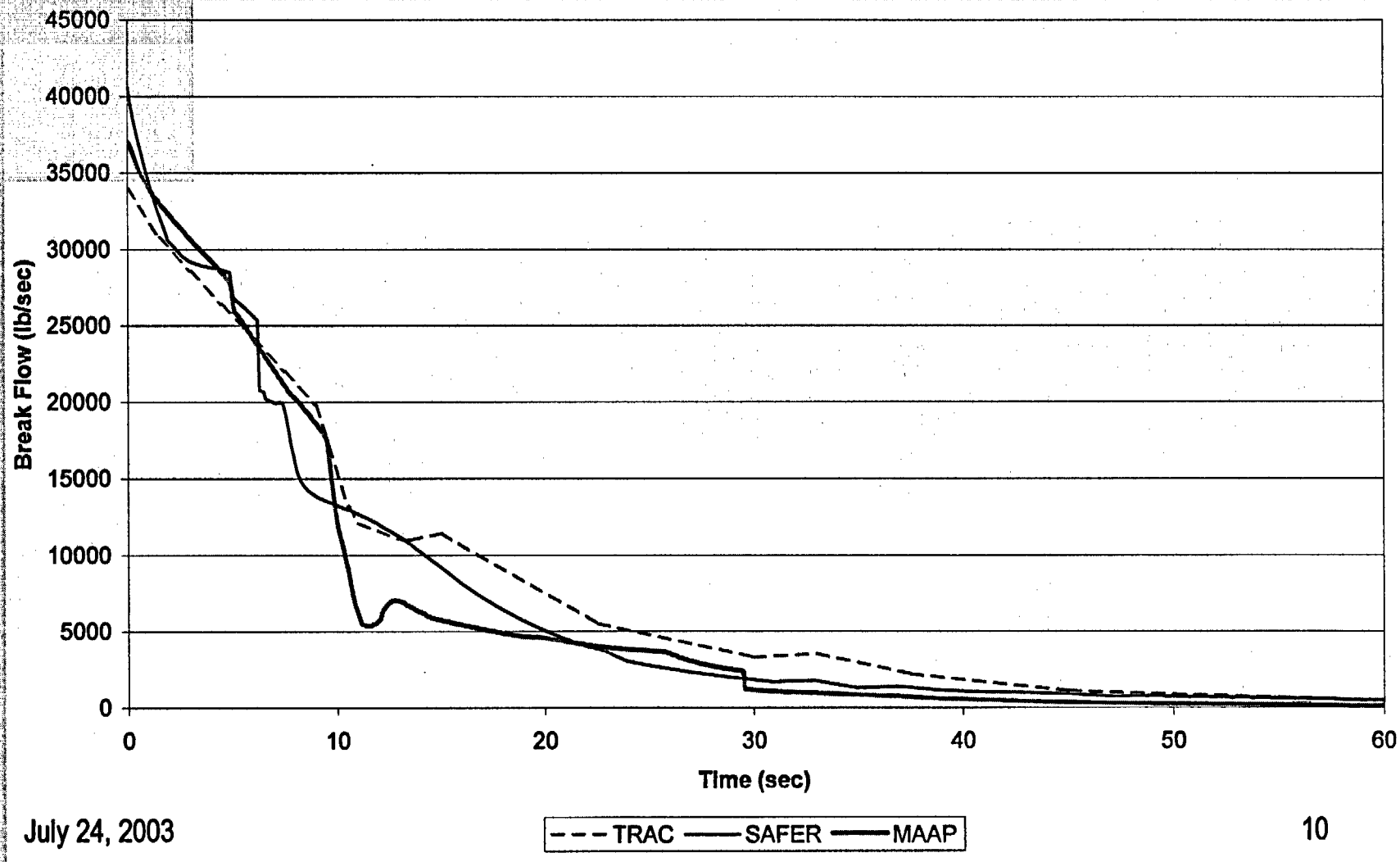
Feedwater


3500
3000
2500
2000
1500
1000
500
0
Flow (lb/sec)
0
1
2
3
4
5
6
7
8
9
10
Time (sec)
SAFER
MAAP

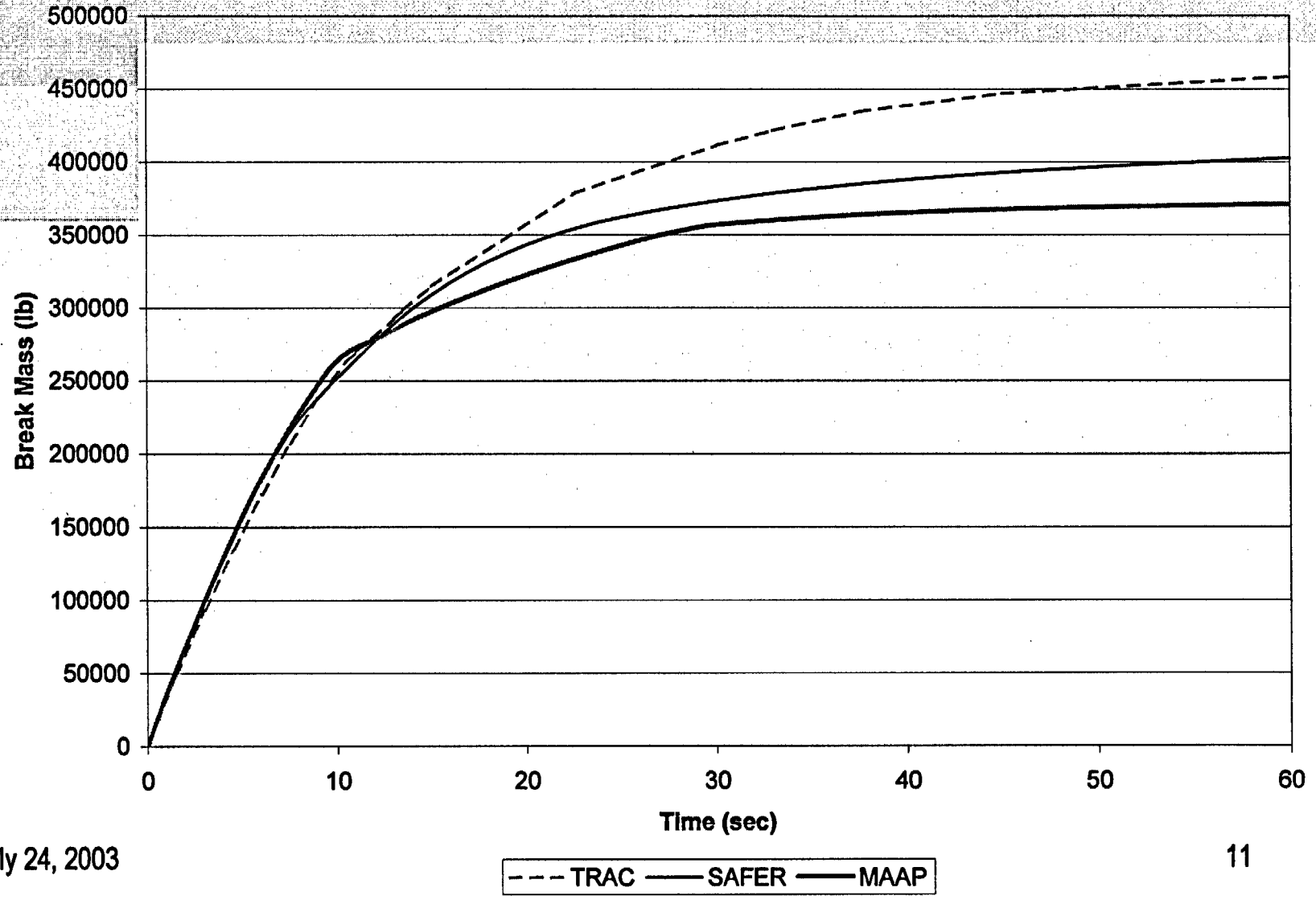
Main Steam Line Flow



Total Break Flow



Integrated Break Flow



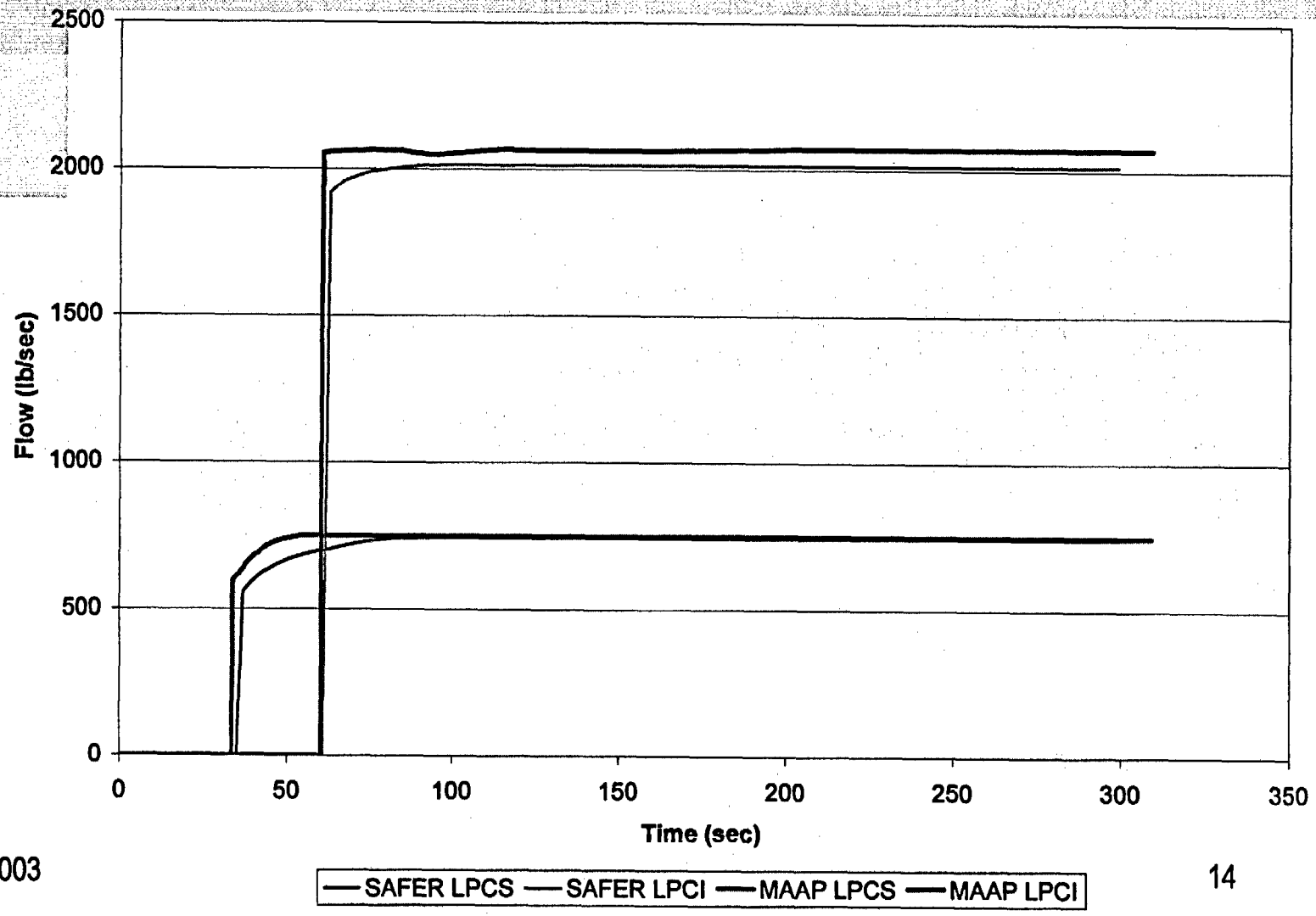
Break Area

- TRACG & SAFER Use Multiple Break Locations to Simulate LBLOCA
  - Recirculation Line, Jet Pump Nozzle Steam, Jet Pump Nozzle Liquid
- Two – Phase Discharge Model
- Matches Experimental Data

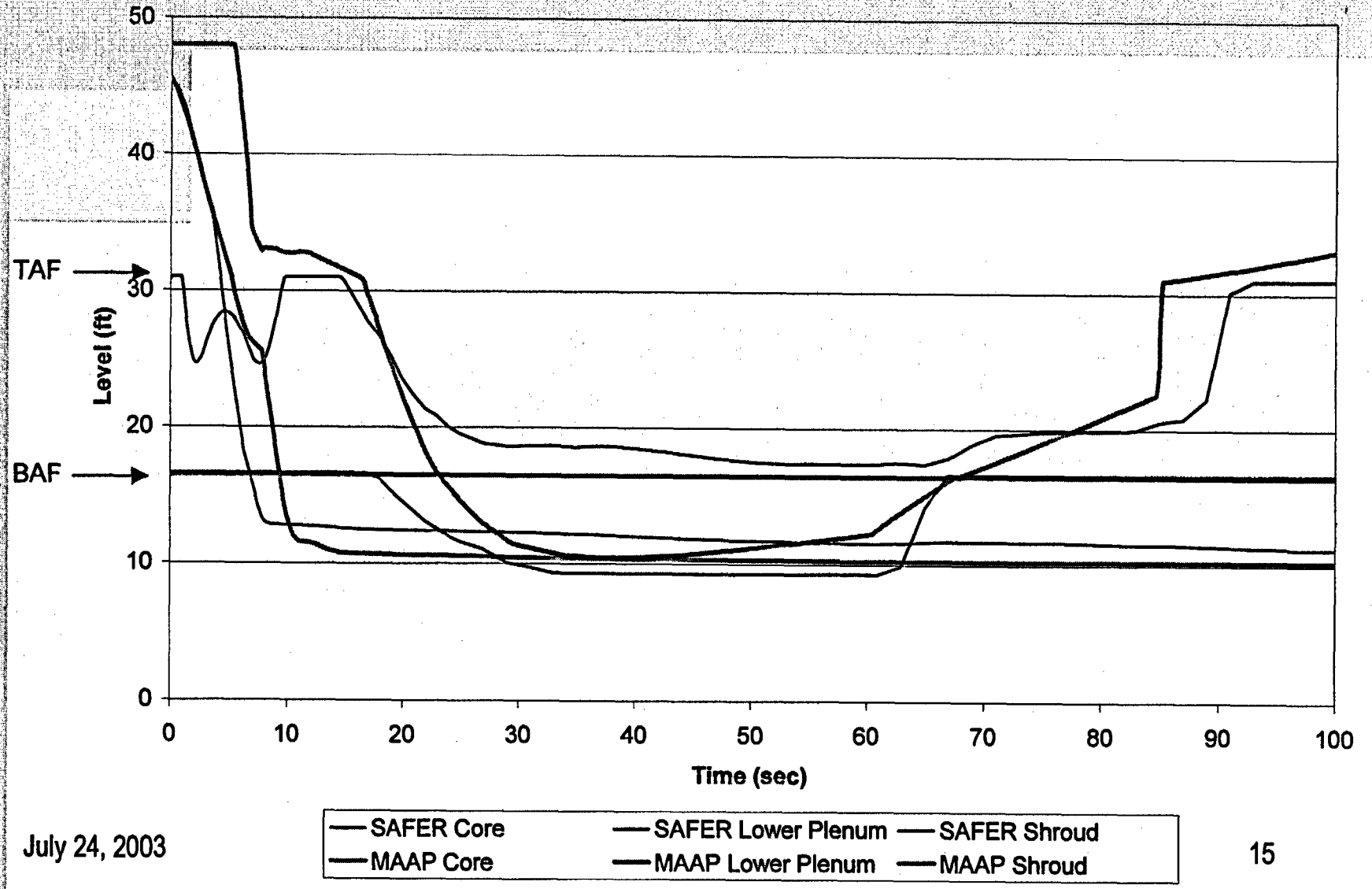
Break Area

- MAAP Uses Single Break Area
- Generalized Openings Used to Model Jet Pump Nozzle
- Simplified Flow Model
  - Adjusted Break Coefficient to Match TRACG & SAFER
- Set Discharge to Environment to Match Downstream Pressure

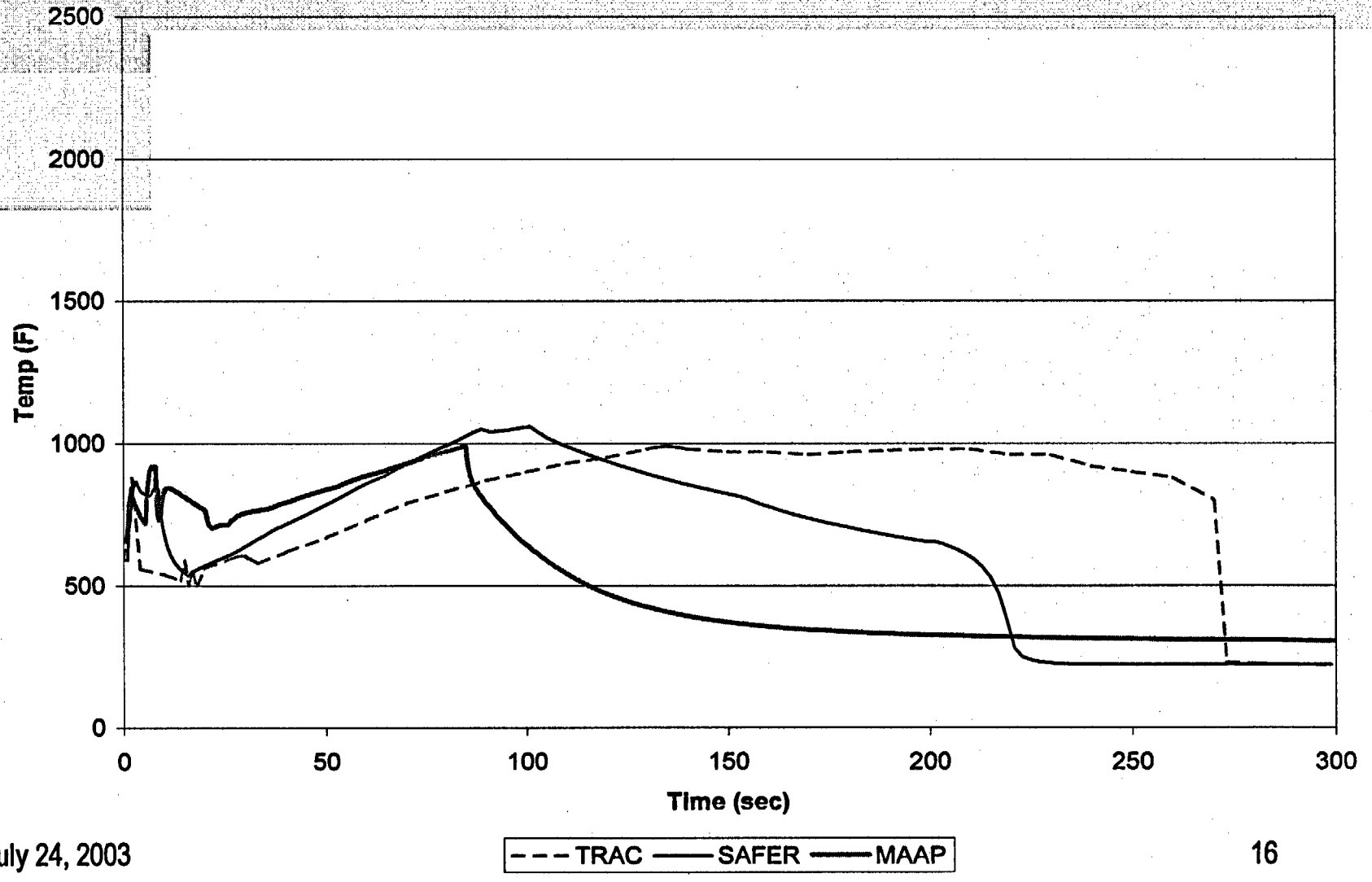
ECCS Flow


2500
2000
1500
1000
500
0
Flow (lb/sec)
0
50
100
150
200
250
300
350
Time (sec)
SAFER LPCS
SAFER LPCI
MAAP LPCS
MAAP LPCI

Water Level


50
40
30
20
10
0
TAF
BAF
Level (ft)
0
10
20
30
40
50
60
70
80
90
100
Time (sec)
SAFER Core
SAFER Lower Plenum
SAFER Shroud
MAAP Core
MAAP Lower Plenum
MAAP Shroud

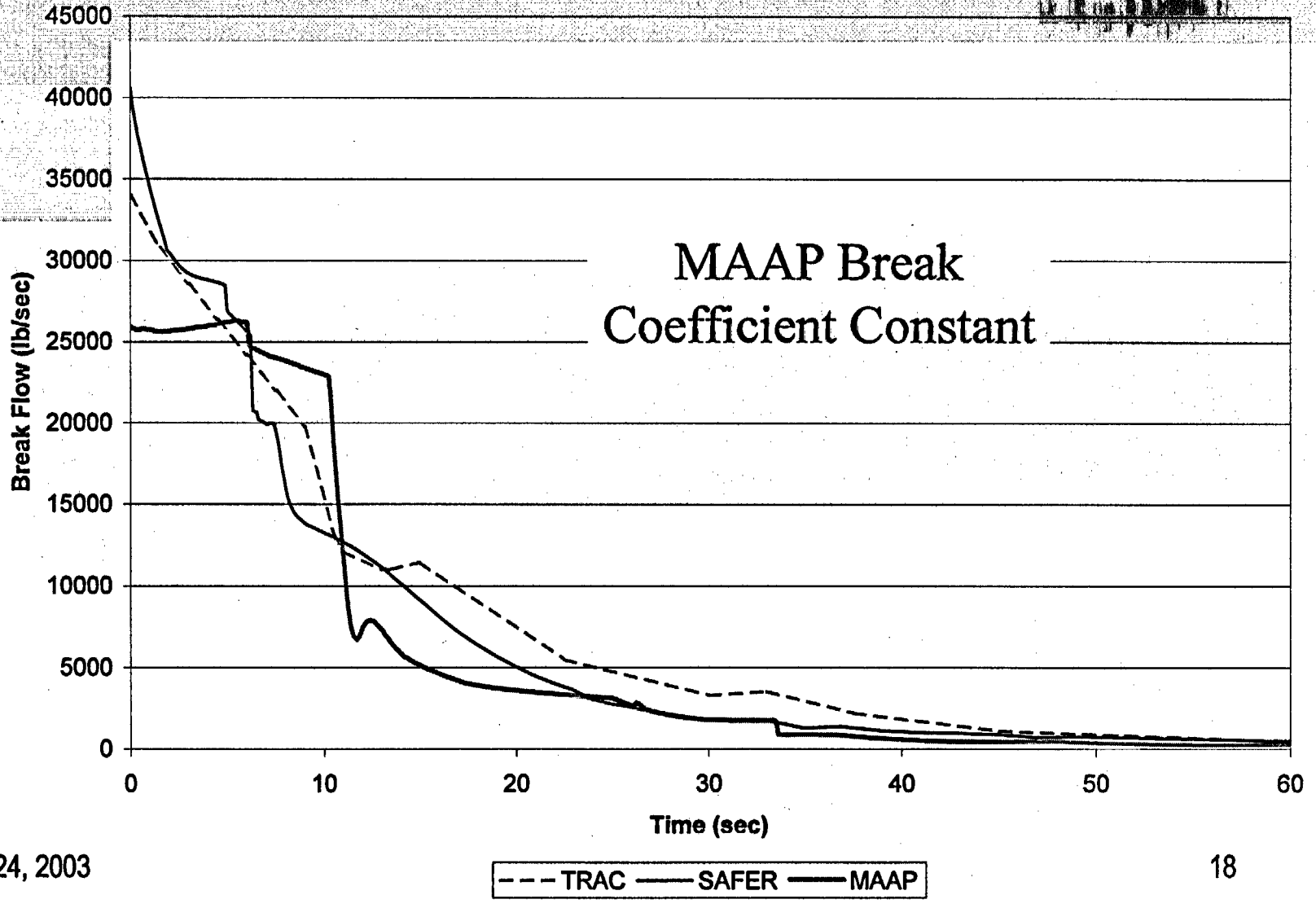
Peak Clad Temperature



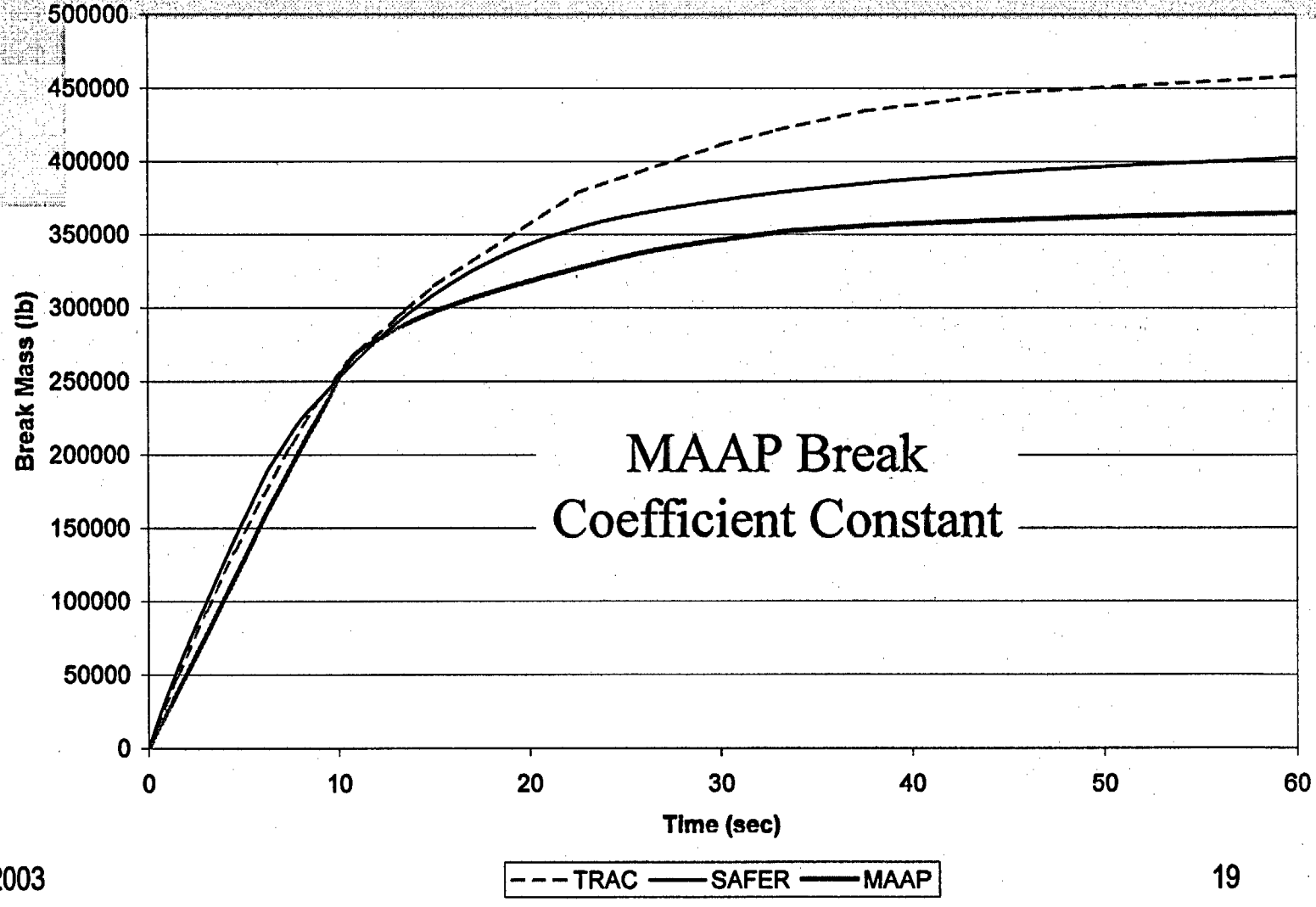
Break Flow Comparison

- Dynamically Modified MAAP Break Flow Coefficient
- Other Break Sizes and Locations Require Different Modeling
- Comparison Case With Constant Break Coefficient (MAAP 4 Default) of 0.7

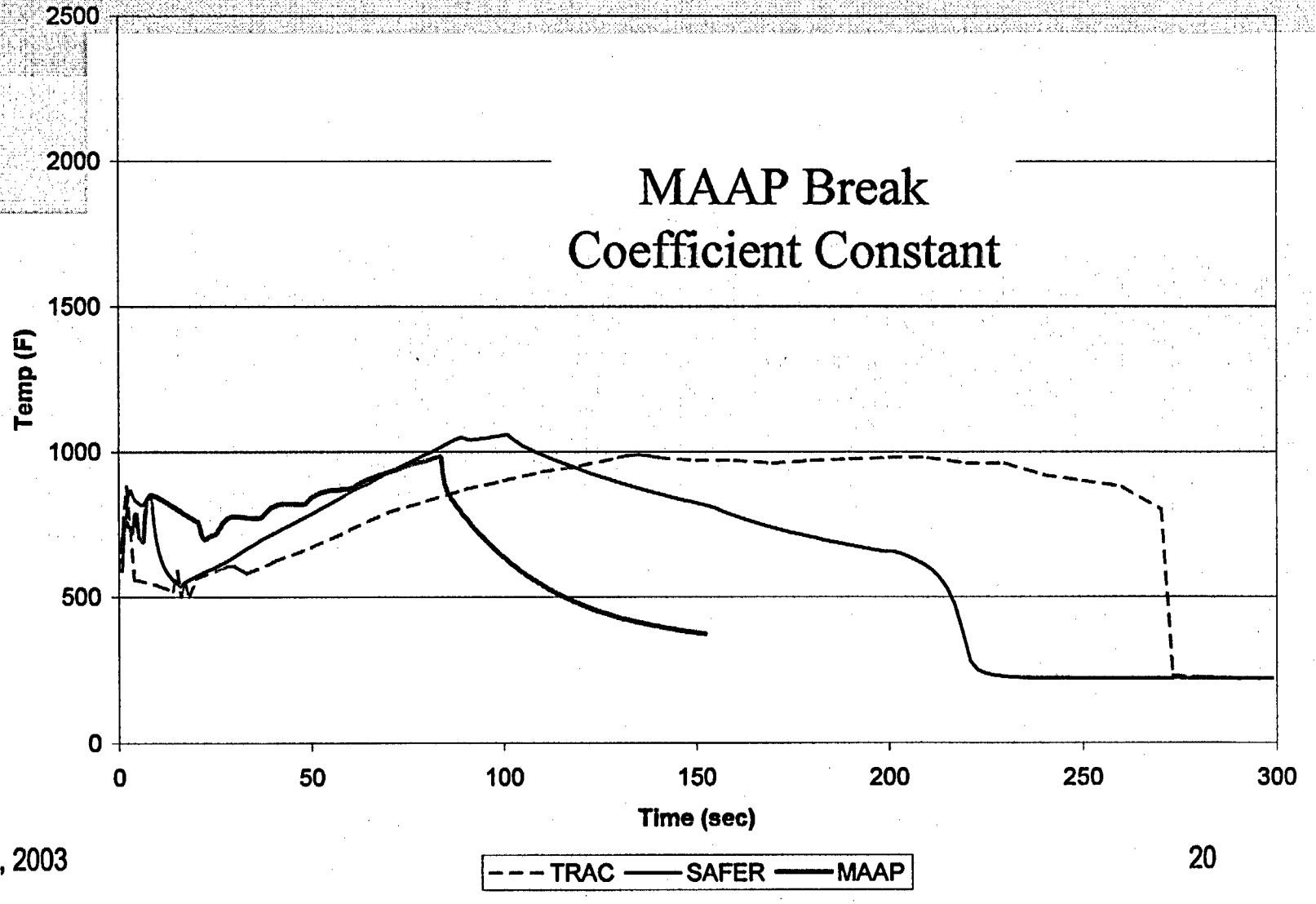
Total Break Flow



Integrated Break Flow



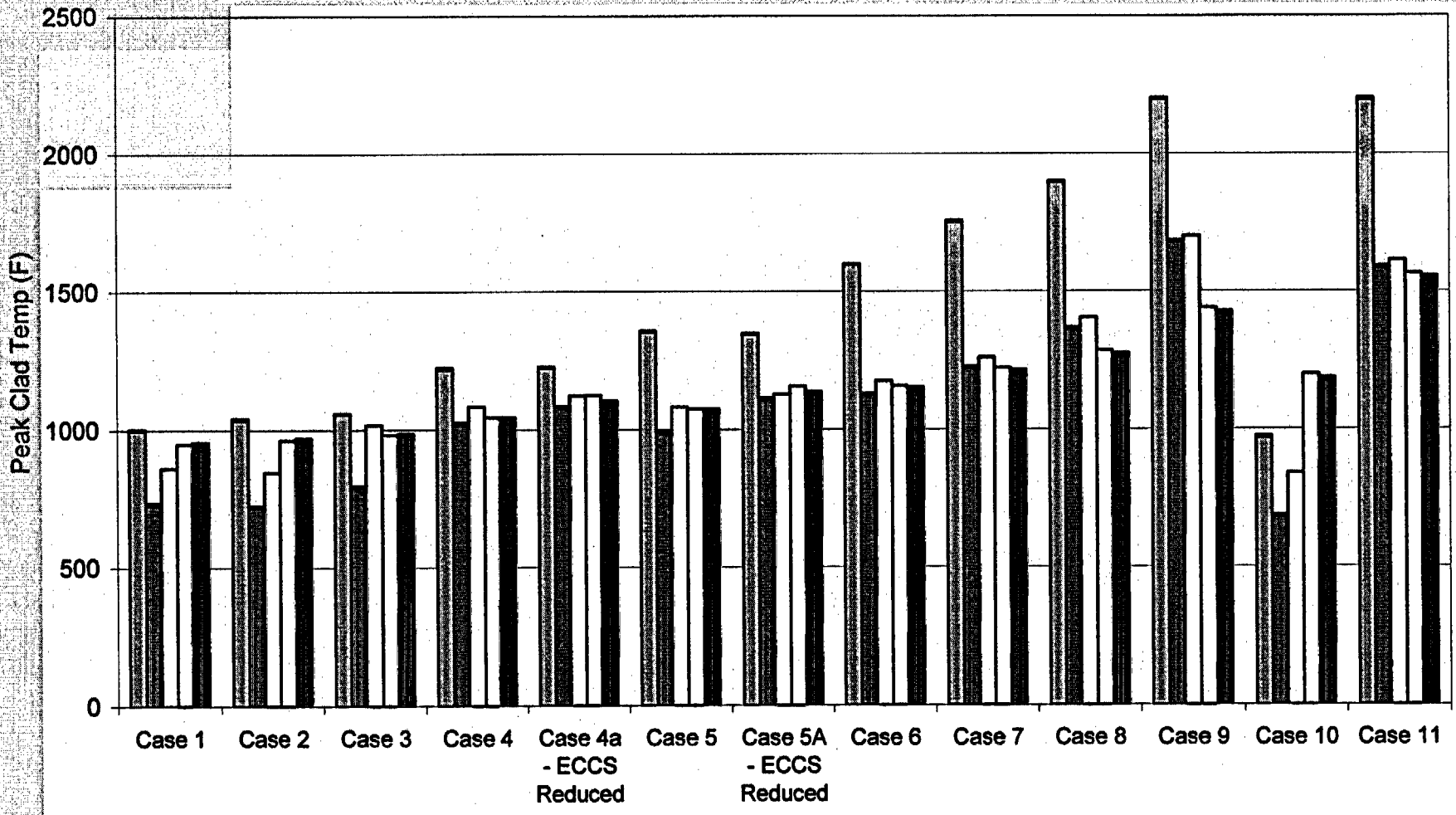
Peak Clad Temperatures



LBLOCA Benchmark Results

Case	LPCS Delay	LPCI Delay	SAFER	TRACG Min	TRACG Max	MAAP (FCBRK Modulated)	MAAP (FCDBRK = 0.7)
Case 1	5	27	1003	736	861	950	956
Case 2	10	32	1042	724	847	963	970
Case 3	15	37	1059	796	1017	982	985
Case 4	30	52	1225	1025	1084	1045	1046
Case 4a - ECCS Reduced	15	37	1228	1085	1123	1125	1106
Case 5	38	60	1357	991	1082	1075	1074
Case 5A - ECCS Reduced	15	37	1348	1114	1129	1158	1138
Case 6	61	83	1599	1130	1176	1158	1153
Case 7	81	103	1756	1227	1261	1223	1216
Case 8	101	123	1900	1369	1404	1287	1276
Case 9	149.5	171.5	2202	1683	1699	1439	1427
Case 10	15		975	687	840	1199	1187
Case 11	133		2202	1591	1612	1563	1554

LBLOCA Benchmark Results



SAFER ■ TRACG Min □ TRACG Max □ MAAP (FCBRK Modulated) ■ MAAP (FCDBRK = 0.7)

Observations

- MAAP and TRACG Cases Compare Well
- LPCI More Effective in MAAP
  - Different Film Boiling Model
- Core Spray More Effective in TRACG – SAFER
  - MAAP Only Removes Heat From Steam
- When MAAP PCT is Acceptable, TRACG PCT Will Also be Acceptable