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Analyses of Fused Salt Mixtures
TO: W. R. Grimes
FROM: R. E. Thoma

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X-RAY DIFFRACTION RESULTS

This memorandum is a report of the X-ray diffraction results of a wide variety of experimental and production efforts. A more extensive report than is contained here has been made to the various workers who have submitted these samples. Other X-ray diffraction results pertinent to the materials discussed herein have been reported previously in CF 57-7-39, CF 57-2-42, CF 56-8-136, CF 56-6-25, and CF 55-12-94.

A large number of results from thermal gradient quenching samples are listed below. The sample designation indicates the originator of the sample, its composition, the relative position of the sample in the gradient quench (by a capital letter; sample "A" is used as the highest temperature in any gradient quenching experiment), and the temperature ($^{\circ}\text{C}$) range from which the sample or samples were quenched.

Example: M-NaZr35U50-A-650

Originator: Moore, Composition: 15 NaF-35 ZrF₄-50 UF₄

All compositions are listed in mole % unless otherwise indicated. CuK α radiation and Ni filters were used exclusively unless otherwise indicated.

1801 RbF-UF₄ quenches

- A. H-RU25-2 N-496 2RbF.UF₄. Sample appears damp.
- B. " X-423 Same as A.
- C. H-RU33.3-1 B-788 Good 2RbF.UF₄.
- D. " Z-673 Same as C.

1802 NaF-BeF₂-ThF₄ quenches

- A. H-NB42T5-1 A-B 380-378 Contains NaF.ThF₄, glass and/or quench growth.
- B. " X-Z 312-305 70 NaF.BeF₂, 30 NaF.ThF₄.
- C. H-NB40T7-2 X-Z 320-316 Same as B.

1803 Service samples

- A. NB66FE1205 Beginning material for 33.3 NaF-66.7 BeF₂ quenches. Practically all glass.
- B. Plug from inside graphite tube M-43FR-1. J. E. Bigelow All 7NaF.6ZrF₄; no ZrO₂. Trace 3NaF.4ZrF₄.
- C. L01-3 No.3051 C-14. Typical C-14 pattern.
- D. C-31 No.3127. G. Nessel. 7NaF.6ZrF₄-3NaF.2ZrF₄ s.s., ~44% ZrF₄.
- E. C-30 No.3057 R. Strehlow. Normal C-30 pattern; optical data shows the solid solution to be biaxial.
- F. No. 3227 J. Norris. Largely unidentified; probably contains several phases. May contain NaF.NiF₂, FeF₂ and possibly some silicates.
- G. SEC12 C-14 + stainless steel. 60 C-12, 15 3KF.UF₄, 15 3KF.CrF₃.

- H. No. 3132 G. Nessel 7NaF.6ZrF₄-3NaF.2ZrF₄ s.s.,
44-45% ZrF₄
- I. No. 3014 G. Nessel 90 KF.ZrF₄, 10 unid.
- J. No. 3021 " Same as I.
- 1804 UO₂F₂ additions to C-35 R. J. Sheil
- A. Dark residue from UO₂F₂ + C-35 mixed in Ni crucible.
20 C-35, 70 U₃O₈, 10 unid. No UO₂F₂
- B. RC35 Ni melt 60 C-35, 40 unid. as in A.
- C. RC35 Pt melt Same as B.
- 1805 NaF-ZrF₄-ThF₄-UF₄ samples H. A. Friedman
- A. F-370 Dark green crystals from 48.5 NaF-44.6 ZrF₄-
3.9 UF₄-3.0 ThF₄. All UF₄.
- B. F-370 47.5 NaF-43.7 ZrF₄-3.8 UF₄-5.0 ThF₄.
90 7NaF.6ZrF₄, 10 unid.
- C. F-370 48.5 NaF-44.6 ZrF₄-3.9 UF₄-3.0 ThF₄.
80 7NaF.6ZrF₄, 20 unid.
- D. F-370 45.0 NaF-41.4 ZrF₄-3.6 UF₄-10.0 ThF₄. Dark
green bottom portion. All UF₄.
- E. F-370 46.2 NaF-42.6 ZrF₄-3.7 UF₄-7.5 ThF₄. All
7NaF.6ZrF₄.

The samples run in this series are probably not representative of the overall composition of the melt nor of the equilibrium phases which should occur.

1806. H-NHf 25-2 Y-Z 792-786 All 3NaF.HfF₄. This pattern shows 3NaF.HfF₄ to be isostructural with 3NaF.ZrF₄. Optical data indicate that this material, like 3NaF.ZrF₄, is biaxial.
- 1807 2NaF.UF₄ equilibrium studies
- A. F-134B 66.7 NaF-33.3 UF₄ All β_3 2NaF.UF₄
(hexagonal $a_1 = 6.11\text{\AA}$, $a_3 = 7.25\text{\AA}$)
- B. 2NaF.UF₄ from A. 20 g samples melted in Ni crucible.
Whole open crucible was dumped into water while mixture was molten. Contains 80 β_3 2NaF.UF₄, 15 γ 2NaF.UF₄
(orthorhombic $a_1 = 5.56\text{\AA}$, $a_2 = 4.01\text{\AA}$), 5 β_2 2NaF.UF₄
(hexagonal, $a_1 = 5.94\text{\AA}$, $a_3 = 3.74\text{\AA}$)
- C. 2NaF.UF₄ from A. 2 g sample + 0.5 g NH₄F.HF heated
to melting point in open Pt crucible, and slowly
cooled. 90 β_2 2NaF.UF₄, 10 γ 2NaF.UF₄.
- D. H-NU33.3-2 D-640 All β_3 2NaF.UF₄
- E. H-NU33.3-2 F-626 (made from B) 30 β_3 2NaF.UF₄,
60 γ 2NaF.UF₄, no β_2 2NaF.UF₄, 10 unid.
- F. H-NU33.3-2 K591 90 β_3 2NaF.UF₄, 10 α 3NaF.UF₄.
- G. H-NU33.3-2 B 480 90 β_3 2NaF.UF₄, 10 α 3NaF.UF₄.

1808 KF-UF₄ Quenches

- A. H-KU 33.3-9 Y-630 All 2KF.UF₄
 B. H-KU 33.3-10 Y-633 " "
 C. H-KU 33.3-7 D-671 " "
 D. " R-626 " "
 E. " S-622 90 2KF.UF₄, 5-10 7KF.6UF₄
 F. " U-613 90 " 10 "
 G. " V-608 50 " 30 " , 20
 cubic and/or tetragonal 3KF.UF₄
 H. H-KU 33.3-9 E-780 All 2KF.UF₄. One should see primary phase 3KF.UF₄ here. This is just above solidus.
 I. H-KU 33.3-11 C-679 90 2KF.UF₄, 10 7KF.6UF₄
 J. " U-633 Practically all 2KF.UF₄, trace 7KF.6UF₄
 K. " Z-615 90 2KF.UF₄, 10 7KF.6UF₄
 The ingrowth of 7KF.6UF₄ between 633 and 615 is considered to confirm the ~ 622° decomposition of 2KF.UF₄.
 L. H-KU25-5 C-624 60 3KF.UF₄ (biaxial blue green form)
 40 cubic and/or tetragonal 3KF.UF₄.
 M. " Y-563 Same as L.
 N. H-KU34.5-2 L-M 774-767 90 2KF.UF₄, 10 7KF.6UF₄
 O. " O-P 753-747 90 " 10 "
 P. " Y 697 50 " 50 "
 N, O, and P show that no equilibrium phases other than 2KF.UF₄ and 7KF.6UF₄ exist between 33.3 and 46.2% UF₄.

1809 Nb90Ni10-103V-369 R. E. Moore 90 NaF.BF₃, 5NaF, 5 unid.1810 NaF-RbF-BeF₂ quenches

- A. RN 27.3 B45.5-424 A-D 370-361. Mostly glass and QG.
 B. " E-G 358-352 Mostly glass. Contains a small amount of a crystallized ternary compound previously observed in LMB 506 and in RN22.2B44-411 R-V 276-266, T-1772.
 C. " P-322 90 ternary compound as in B, 10 unid.
 D. " T-V 308-300 Same as C.
 E. RN22.2B33.3-423 A-D 372-303 Entirely the pattern of the phase previously labeled 2NaF.RbF.BeF₂. The X-ray and optical results of this quench show that this ternary compound has the formula 2NaF.3BeF₂.4RbF.
 F. " S-U 308-300 All 2NaF.3BeF₂.4RbF.
 G. RN22.2B33.3-427 H-542 95 2NaF.3BeF₂.4RbF, 5 unid.

1811 KF-UF₄ slowly cooled melts.

- A. 66.7 KF-33.3 melted in Ni crucible in open air.
90 2KF.UF₄, 10 7KF.6UF₄; possible traces
cubic 3KF.UF₄. 2KF.UF₄ form here is identical
with that observed in hydrofluorinated
melts.
- B. 60 KF-40 UF₄ melted in Ni crucible in open air.
50 2KF.UF₄-50 7KF.6UF₄
- C. Single crystals of KF.6UF₄ separated from open air melt
of 30KF-70UF₄. Several patterns were made from these
crystals for X-ray standard of KF.6UF₄.

1812 NaF-RbF-BeF₂ Quenches

- A. RN22.2B33.3-427 A-D 454-443 All 2NaF.3BeF₂.4RbF
- B. " " T-V 473-463 " "
- C. " -428 A 603 40 2NaF.3BeF₂.4RbF,
60 2RbF.BeF₂
- D. " F-G 577-570 Practically all NaF.3BeF₂.4RbF
traces NaF.BeF₂
- E. " H-J 562-550 All 2NaF.3BeF₂.4RbF
- F. " S 483 " "
- G. RN22.2B33.3-425 E-H 439-428 90 " ,
10 2RbF.BeF₂
- H. " S-V 380-368 80 2NaF.3BeF₂.4RbF,
20 2RbF.BeF₂

1813 NaF-LiF-BeF₂ Quenches (R. E. Meadows)

- A. LiF-BeF₂ M-1 beginning material. 70 2LiF.BeF₂, 20 BeF₂,
10 LiF.BeF₂
- B. NB60L5-434 A-E 342-328 NaF.BeF₂ and glass
- C. " F-I 324-313 90 NaF.BeF₂, 10 BeF₂
- D. NB50L40-431 A-D 296-290 Practically all 2LiF.BeF₂,
traces BeF₂, (sample sticky)
- E. " Q-S 253-246 40 BeF₂, 40 2LiF.BeF₂, 20 unid.
- F. NB50L45-432 A 296 Same as E.
- G. " F 285 80 2LiF.BeF₂, 20 BeF₂
- H. " I 276 90 " , 10 "
- I. " N 260 45 " , 45 " , 15 unid. (same
as in E)
- J. NB50L30-429 A-B 298-295 Practically all glass.
- K. " C-E 293-289 " " ; traces
2LiF.BeF₂
- L. " G 285 90 2NaF.2LiF.3BeF₂, 10 2LiF.BeF₂
- M. " S-T 250-246 30 2LiF.BeF₂, 50 BeF₂, 20 NaF.BeF₂
- N. NB65L5-433 A-B 343-338 BeF₂ and glass
- O. " M 301 " " "
- P. NB60L10-435 A-F 343-326 BeF₂ and glass
- Q. NB60L5-434 Q 280 90 NaF.BeF₂, 10 NaF.BeF₂.
- R. NB60L10-435 K-M 306-299 90 BeF₂, 10 NaF.BeF₂.
- S. " N-Q 293-280 70 " 30 "

T. NB60L15-436 A 343 BeF₂ and glass
 U. " M 300 " " "
 V. " R 280 " " "
 W. NB50L5-437 A-D 347-338 All NaF.BeF₂

1814 NaF-HfF₄ Quenches

A. H-NHf33.3-5 O 591 Practically all β_3 2NaF.HfF₄, trace NaF.HfF₄ (probably in QG)
 B. " R 577 Practically all β_3 2NaF.HfF₄, trace 3NaF.HfF₄.
 C. H-NHf40-2 C-559 70 7NaF.6HfF₄, 40 β_4 2NaF.HfF₄, 10 unid. β_4 is probably in QG.
 D. " J-N 525-502 50 7NaF.6HfF₄, 50 β_4 2NaF.HfF₄
 E. " S 472 50 " , 50 "
 F. " W-Y 449-437 60 " , 40 β_3 2NaF.HfF₄
 G. H-NHf50-1 B-C 635-633 80 NaF.HfF₄, 10 7NaF.6HfF₄, 10 unid.
 H. H-NHf75-1 Q-S 531-517 40 HfF₄, 70 7NaF.6HfF₄, 20 NaF.HfF₄
 I. H-NHf80-1 R-T 537-527 Same as H.
 J. H-NHf35-1 G-583 80 β_3 2NaF.HfF₄, 20 β_4 2NaF.HfF₄, traces NaF.HfF₄
 K. " N-561 45 β_3 2NaF.HfF₄, 50 β_4 2NaF.HfF₄, 5 7NaF.6HfF₄
 L. " U-532 30 β_3 2NaF.HfF₄, 70 β_4 2NaF.HfF₄

1815 R. J. Sheil mixtures

A. NaNO₃ + UF₄. All unidentified material. Does not appear to contain UO₂F₂, UO₂, NaF-UF₄ phases, UO₃, U₃O₈, UF₄, or NaNO₃.
 B. R5501 C-35. 90 NaF.BeF₂, 10 unid.
 C. RS 500. Same as A.
 D. Na₂UO₄ from J. White. Origin unknown. Pattern used for tentative standard for Na₂UO₄.

1816 K₂SO₄-Li₂SO₄ mixtures and additions

A. 20 wt % K₂SO₄-80 wt % Li₂SO₄ eutectic. Pattern used for supporting solvent standard in reference to samples B and C.
 B. K₂SO₄-Li₂SO₄ from A. + 1 wt % UF₄. Same as A.
 C. " + 1 wt % UF₄ + 1 wt % UO₂. Trace UO₂; no UF₄
 D. UO₂ heated to 1600°C. Good standard quality UO₂.

1817 Beginning reagent materials

A. SnF₂. McKay. Same as BJS No. EV. Does not fit City Chemical Batch No. 1800. Some lines disappear on heating.
 B. SnF₂. McKay. After melting. A few lines appear here not present in the beginning material. In addition, a few of those in A. have disappeared. No ASTM standard for SnF₂.

- C. BaF_2 B. and A. (Reagent Grade) R. E. Meadows.
This BaF_2 (ASTM: f.c.c., $a_0 = 6.2001$) is of smaller size than ASTM standard. Some solid solution apparent. L. Harris sees some birefringent material present.
- 1818 H-NB35T7-3 R-T 481-470 80 $2\text{NaF} \cdot \text{ThF}_4$, 20 unid.
- 1819 BJS samples
A. CrF_2 No. PW. 60 CrF_2 , 30 CrF_3 , 30 unid.
B. CrF_2 No. IS. Good CrF_2 . (McVay corroborates)
C. CrF_2 No. NY. 70 CrF_2 , 30 unid.
D. CrF_2 No. MY. Good CrF_2 , same as B.
E. Crystals from lump of fused CrF_2 . 40 CrF_2 , 60 unid., (same unid. as in C.)
Unidentified lines same as in all samples.
- 1820 Volatility Experiment samples. J. E. Bigelow
A. Run C-15 xx-5b 30 $7\text{NaF} \cdot 6\text{ZrF}_4 \cdot 3\text{NaF} \cdot 2\text{ZrF}_4$ s.s., 70 $\text{NaF} \cdot \text{NiF}_2 \cdot 2\text{ZrF}_4$.
B. Run C-15 xx-1b All NiF_2
C. Run C-15 xx-3b 60 NiF_2 , 30 $\text{NaF} \cdot \text{NiF}_2 \cdot 2\text{ZrF}_4$, 10 $\beta_2 2\text{NaF} \cdot \text{ZrF}_4$
D. Pink surface crystals from C-14-CR-1
50 NiF_2 , 30 $\text{NaF} \cdot \text{NiF}_2 \cdot 2\text{ZrF}_4$; no $\text{NiF}_2 \cdot \text{ZrF}_4$; no ZrO_2 ; traces $\text{NaF} \cdot \text{NiF}_2$; 20 unid. (probably oxyfluoride)
E. C-15 xx-2b 90 NiF_2 , 10 $\text{NaF} \cdot \text{NiF}_2 \cdot 2\text{ZrF}_4$
- 1821 NaF-LiF-BeF_2 Quenches R. E. Meadows and R. E. Moore
Many of these samples permit no quantitative estimate as to relative amounts of phases present. Phase designations:
 $7 = 2\text{NaF} \cdot \text{LiF} \cdot \text{BeF}_2$, $228 = 2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$, $L_3 = \text{LiF} \cdot \text{BeF}_2$, $L_4 = 2\text{LiF} \cdot \text{BeF}_2$, $N_3 = \text{NaF} \cdot \text{BeF}_3$, $N_4 = 2\text{NaF} \cdot \text{BeF}_2$, G = glass.
- A. NB 50L10-438 Q-S 295-289 90 N_3 , 10 7
B. NB 50L15-439 H-J 329-319 Mostly G, small amount N_3 , no BeF_2 .
" E-G 337-330 " " trace BeF_2
C. NB45L20-443 A-B 320-318 Only crystalline material is 7 .
" C 316 7 and G
" G 305 7
" L 290 All 7 , no 228
" M 287 " " "
" N 285 " " "
" O 282 " " "
" P 280 80 7 , 20 228
" R 273 70 7 , 30 228
" U 264 40 BeF_2 , 40 7 , 20 N_3
D. NB45L25-444 D 313 7 , G, and unid. (probably QG containing incipient crystals of L_4)
" H-J 301-295 90 7 , 10 unid.

NB45L25-444 N 283 7 and unid., probably QG containing L_4 .
 " O 280 40 228, 40 7, 20 unid., no BeF_2 .
 " P-Q 277-274 60 7, 30 228, 10 L_4 .
 " T 265 60 7, 20 L_4 , 20 N_3

E. NB45L30-445 A 319 All G
 " E 310 L_4 + G
 " Q 272 60 7, 30 228, 10 L_4
 " S-T 265-262 60 L_4 , 20 7, 20 228, tr. BeF_2 .

F. NB45L35-446 A-K 319-292 L_4 and probably some G
 " N-O 283-280 40 L_4 , 30 7, 30 228
 " R-T 270-264 40 L_4 , 40 7, 20 228

G. NB47L20-447 A 324 Small amount 7, and G.
 " H 305 " " " " "
 " J 299 7, possible tr. BeF_2 , no N_3 ,
 may contain some G.
 " L 293 7 and unid., may contain some BeF_2 .
 " N 286 7 and QG
 " P 279 unid., traces 228 and 7
 " R 273 N_3 , traces 228, and 7.
 " U 264 Largely N_3 , trace 7, and 228.

H. NB47L23-448 A 323 L_4 and QG
 " D 315 7 and QG
 " J 298 Mostly 7, may contain trace N_3 .
 " L 292 Mostly 7, some unid.
 " O-P 282-279 60 7, 40 228, probably some G
 " S-U 270-263 40 228, 40 7, 20 N_3 , tr. unid.

I. NB47L27.5-449 I 302 Trace 7, and G
 " J 298 " 7, mostly G
 " N 285 7, probably G, no 228, or L_4 .
 " P 279 Largely 228, trace L_4 and 7.

J. NB47L30-450 B 319 All G
 " M 287 " "
 " N 283 QG and L_4
 " O 280 Mostly 228
 " P-R 277-272 BeF_2 , L_4 and 228
 " U-S 269-264 BeF_2 and L_4

K. NB55L25-451 J-L 290-287 All G
 " M-O 284-278 BeF_2 and unid.
 " Q-T 270-262 BeF_2 , 228, and L_4

L. NB55L30-452 R-268 BeF_2 , L_4 and 228
 " S-265 BeF_2 and G
 " T-262 60 BeF_2 , 20 228, 20 L_4

M. NB55L35-453 B-L 318-284 BeF_2 and L_4
 " M 281 BeF_2 , 228, and L_4
 " N-P 278-270 50 BeF_2 , 25 228, 25 L_4
 " O 274 BeF_2 , L_4 and 228
 " R-T 267-260 BeF_2 , L_4 and 228

N. NB55L25-458 K-L 290-286 tr. BeF_2 and 228, mostly G
 " M-N 283-279 " " "

1822 KF-UF₄ Quenches

- A. H-KU40-3 M-N 621-614 50 2KF.UF₄, 50 7KF.6UF₄.
- B. " O-P 607-599 10 3KF.UF₄, 90 "
- C. " A'-B' 522-515 5 3KF.UF₄, 95 7KF.6UF₄
- D. " Q-R 591-585 Same as B.
- E. H-KU33.3-11 A 682 (yellow and green mixture) Contains unidentified material and cubic 3KF.UF₄
- F. H-KU33.3-12 B 622 Oil had leaked into top 5 samples. Material is unidentified.
- G. H-KU33.3-12 E' 70 7KF.6UF₄, 30 3KF.UF₄ (cubic)
- H. H-KU33.3-14 Q-R 615-613 2KF.UF₄, trace 7KF.6UF₄
- I. " U-V 604-601 20 2KF.UF₄, 80 7KF.6UF₄
- J. H-KU33.3-13 S-T 613-611 2KF.UF₄, trace 7KF.6UF₄
- K. " U-V 608-605 Same as J.
- L. H-KU33.3-9 F 776 50 2KF.UF₄, 50 unid.
- M. H-KU33.3-7 Q 630 All 2KF.UF₄

1823 BeF₂-ThF₄ Quenches

- A. H-BT1-1 K-L 540-534 Probably mostly glass. Traces BeF₂
- B. " M-N 529-521 Mostly BeF₂; trace unid. material.
- C. " Q-T 503-485 80 BeF₂; 20 unid.
- D. H-BT3-1 A,J,L 591-541 All glass.
- E. H-BT4-1 R,T₃ 510-480 50 BeF₂, 40 ThF₄ (reduced cell size), 10 unid.
- F. H-BT2-1 S-Y 496-460 Identical with E.

1824 Samples from G. M. Watson's group

- A. Ce¹⁴¹F₃ (RAS) This is the beginning material for CeF₃ additions to subsequently reported mixtures
- B. BW37 Reactor heel. C-45 + 6 wt % CeF₃. 800°C filtration. 95 7NaF.6ZrF₄, 5 CeF₃.
- C. BW31-4 C-45 + CeF₃. 95 7NaF.6ZrF₄, 5 unid. No NaF.CeF₃, CeF₃, or ZrO₂.
- D. 37KF-37LiF-10.4CeF₃-15.6MgF₂ No. 1. J. Shaffer
- E. " No. 2. "
- F. " No. 3. "
- D.-F. identical: 65 KF, 25 LiF, 15 unid., no MgO, NaF.CeF₃, MgF₂, or CeF₃.
- G. B-NC 50-128 A-H 662-638. Used as standard for NaF.CeF₃
- H. BW37-1 NaF.CeF₃ added to 59 NaF-41 ZrF₄. Practically all 7NaF.6ZrF₄. No CeF₃ or NaF.CeF₃.
- I. BW37-1 Heel. 95 7NaF.6ZrF₄, 5 CeF₃. Possible traces α or β 2NaF.ZrF₄.
- J. 50 KF-50 LiF + 10 Na₂O₂ + 10 BaF₂. J. Shaffer. 80 NaF-LiF-KF mixture, 20 unid. Traces BaF₂ and BaO. Unid. is probably a KF-BaF₂ phase.

1825 Service samples

- A. Scale on sides of sump pump bowl from 1000 hour C-107 Inor loop. G. Brady. All UO₂.

- B. Cl3-2T-1 J. Bigelow. NaF pellets containing adsorbed Cr phases; pink to orange in color. 90 NaF, 10 unid. phase or phases resembling $2\text{NaF} \cdot \text{CrF}_2$. No CrF_2 , or CrF_3 .
- C. Corrosion product from LiCl-KCl in 347 s.s. tube. S. Cohen. No Fe or Cr chlorides. Very poor pattern. No definite identification of products.
- D. E.E. 1209 C-125 70 NaF. BeF_2 , 20 NaF. ThF_4 , 10 $\beta 2\text{NaF} \cdot \text{BeF}_2$.
- E. E.E. 1202 C-125 90 " " 10 $\beta 2\text{NaF} \cdot \text{BeF}_2$.
D.-E. gave abnormally low ThF_4 by chemical analyses.
- F. No. 3238 C-122 All $7\text{NaF} \cdot 6\text{ZrF}_4 - 3\text{NaF} \cdot 2\text{ZrF}_4$ s.s.
- G. Fused sample of C-122 from V-O. experiment.
 $7\text{NaF} \cdot 6\text{ZrF}_4 - w\text{NaF} \cdot 2\text{ZrF}_4$ and a small amount of poorly crystallized material resembling $2\text{NaF} \cdot \text{ZrF}_4$.
- 1826 NaF-HfF₄-ZrF₄ Quenches
- A. H-NZ37.5 Hf 12.5-1 Z-478 60 7:6, 30 1:1, 10 unid.
- B. H-NZ25 Hf 25-1 Z-477 70 7:6, 30 1:1, trace unidentified.
- C. H-NZ12.5 Hf 37.5-1 Z-475 90 7:6, no 1:1, 10 unid.
The compound pairs $7\text{NaF} \cdot 6\text{ZrF}_4 - 7\text{NaF} \cdot 6\text{HfF}_4$ and $\text{NaF} \cdot \text{ZrF}_4 - \text{NaF} \cdot \text{HfF}_4$ produce X-ray patterns so similar that only ratio designations of the phases are listed here.
- 1827 NaF-HfF₄ quenches
- A. H-NHf33.3-5 P-Q 585-582 90 $\gamma 2\text{NaF} \cdot \text{HfF}_4$, 10 $\alpha 5\text{NaF} \cdot 2\text{HfF}_4$, Petrog. (C.W.) $\alpha 5\text{NaF} \cdot 2\text{HfF}_4$ and QG. X-ray shows the QG is practically all $\gamma 2\text{NaF} \cdot \text{HfF}_4$.
- B. H-NHf33.3-5 R Practically all $\beta 2\text{NaF} \cdot \text{HfF}_4$.
Trace $3\text{NaF} \cdot \text{HfF}_4$.
- C. H-NHf44-1 C 533. C.W.: 1:1 + QG. X-ray: 90 $7\text{NaF} \cdot 6\text{HfF}_4$, 10 $\text{NaF} \cdot \text{HfF}_4$.
- D. " D-E 530-526. C.W. 7:6 + Q.G. X-ray: 90 $7\text{NaF} \cdot 6\text{HfF}_4$, 10 $\text{NaF} \cdot \text{ZrF}_4$.
- 1828 B. J. Sturm's samples
- A. No. RY CrF_2 . Good CrF_2 ; no CrF_3
- B. No. PY " " " " "
- C. No. QY " " " " "
- D. No. SY Sediment 90 CrF_2 , 5 CrF_3 , 5 unid.
- E. No. IZ $\text{PbF}_2 \cdot \text{ZrF}_4$. McVay: good single phase material. This pattern is used for X-ray standard for $\text{PbF}_2 \cdot \text{ZrF}_4$.
- F. No. FZ $\text{CdF}_2 \cdot \text{ZrF}_4$. McVay: microcrystalline; phases not good enough to get optical data. X-ray: there appears to be a partly formed product or products, but both reactants are present in excess.
- G. No. HZ $\text{BaF}_2 \cdot \text{ZrF}_4$ McVay: microcrystalline. X-ray: This sample contains neither BaF_2 nor ZrF_4 . It may not be single phase but reaction seems to have occurred.
- H. No. JZ $\text{BiF}_3 \cdot \text{ZrF}_4$ McVay: No reaction. X-ray: No BiF_3 present; 40 ZrF_4 , 60 unid.
- I. No. GZ $\text{CdF}_2 \cdot \text{ZrF}_4$ Same as No. FZ.

- J. No. CZ $2\text{NaF} \cdot \text{CoF}_2$. McVay: mixture of $\text{NaF} \cdot \text{CoF}_2$ and NaF
X-ray: " " " "
- K. No. DZ $\text{CoF}_2 \cdot \text{ZrF}_4$. This X-ray pattern appears to be that
of a phase which is isomorphous with FeF_2 but which has
a smaller cell size. Used as tentative standard for
 $\text{CO}_2 \cdot \text{ZrF}_4$.
- L. No. BZ $\text{NaF} \cdot \text{CoF}_2$ Used as standard for $\text{NaF} \cdot \text{CoF}_2$.
McVay: O.K.
- M. No. NZ $\text{SnF}_2 \cdot \text{ZrF}_4$ McVay: two phases, no ZrF_4 .
X-ray: all unid. material.
- N. No. KZ $\text{NaF} \cdot \text{CuF}_2$ McVay: contains much Cu_2O in addition
to another fairly well-formed phase. X-ray: list
tentative standard for a $\text{NaF} \cdot \text{CuF}_2$ phase from this pattern.

1829 $\text{NaF} \cdot \text{HfF}_4$ Quenches

- A. H-NHf31-1 N-O 624-616 60 $\gamma 2\text{NaF} \cdot \text{HfF}_4$, 20 $\alpha 5\text{NaF} \cdot 2\text{HfF}_4$,
20 $\beta 5\text{NaF} \cdot 2\text{HfF}_4$
- B. " Q-R 600-592 50 $\alpha 5\text{NaF} \cdot 2\text{HfF}_4$, 50 $\gamma 2\text{NaF} \cdot \text{HfF}_4$.
- C. H-NHf35-1 F-H 585-580 95 $\gamma 2\text{NaF} \cdot \text{HfF}_4$, 5 $7\text{NaF} \cdot 6\text{HfF}_4$.
- D. " X-Y 518-514 80 γ " , 10 $\alpha 5\text{NaF} \cdot 2\text{HfF}_4$,
10 $7\text{NaF} \cdot 6\text{HfF}_4$
- E. H-NHf54-1 B-C 536-533 Practically all $7\text{NaF} \cdot 6\text{HfF}_4$.
This sample is probably off composition.

1830 H-NK32U58-1 X-A' 707-693 50 $\text{KF} \cdot 2\text{UF}_4$, 50 $7\text{K}(\text{Na})\text{F} \cdot 6\text{UF}_4$,
no UF_4 .

1831 F-450 $\text{LiF} \cdot \text{BeF}_2 \cdot \text{ThF}_4$ slowly cooled melts. H. A. Friedman

1. 40LiF- 5ThF₄- 5BeF₂ 50LiF.2ThF₄, 25LiF.BeF₂, 25 BeF₂.
2. 45 " -10 " -45 " 50 " , 40 2LiF.BeF₂, 10 BeF₂.
3. 50 " - 5 " -45 " 50 " , 50 LiF.BeF₂, tr.
2LiF.BeF₂.
4. 50 " -10 " -40 " 35 " , 60 2LiF.BeF₂, 5 BeF₂.
5. 55 " - 5 " -10 " 50 " , 50 " .
6. 55 " -10 " -35 " 70 " , 30 " , probably
traces BeF₂.
7. 55 " -10 " -35 " 70 " , 30 2LiF.BeF₂, probably
traces BeF₂.
- (second batch)
8. 58 " - 7 " -35 " 40 " , 60 2LiF.BeF₂; no BeF₂.
9. 60 " - 4 " -36 " 30 " , 60 " , 10 LiF.BeF₂,
tr. BeF₂.
10. 60 " - 5 " -35 " 50 " , 50 " .
11. 60 " - 8 " -32 " 60 " , 30 " , 10 ThF₄;
no LiF.4ThF₄.
12. 61 " -20 " -19 " 60 3LiF.ThF₄ s.s., 30 LiF.2ThF₄,
10 2LiF.BeF₂.
13. 64 " - 5 " -31 " 40 3LiF.ThF₄ s.s., 60 2LiF.BeF₂;
possible trace 7LiF.6ThF₄.
14. 65 " -10 " -25 " 70 3LiF.ThF₄ s.s., 20 2LiF.BeF₂,
10 LiF.2ThF₄.

15.	68LiF-5	ThF ₄ -27	BeF ₂	40	3LiF.ThF ₄ s.s.,	60	2LiF.BeF ₂ .
16.	68.5"-5.5 "	-26 "	"	70	"	10 "	"
						30	LiF.2ThF ₄
17.	69.5"-7.5 "	-23 "	"	80	"	20	LiF.2ThF ₄ .
18.	70 "-10 "	-20 "	"	60	"	40	2LiF.BeF ₂ .
19.	70 "- 5 "	-25 "	"	70	"	20 "	"
						10	LiF.BeF ₂ .
20.	71 "- 16 "	- 8 "	"	All	3LiF.ThF ₄ ;	no 20	shifts.
21.	71.5"-13.5"	-15 "	"	80	"	10	2LiF.BeF ₂ ,
						10	LiF.BeF ₂ .
22.	72 "- 8 "	-20 "	"	80	3LiF.ThF ₄ s.s.,	20	2LiF.BeF ₂ .
23.	72 "- 3 "	-25 "	"	60	"	20 "	"
						20	LiF.
24.	72 "- 6 "	-22 "	"	60	"	20	2LiF.BeF ₂ ,
						10	LiF.BeF ₂ , trace LiF.
25.	73 "- 20 "	- 7 "	"	All	3LiF.ThF ₄ .	The 3LiF.ThF ₄	can
						apparently dissolve 7 mole % BeF ₂	with appreciably
						affecting the cell parameters.	

1832 Production samples. J. Truitt.

- A. Y-Z YF₃ from Y₂O₃ + HF. All YF₃
 B. Y-3A. All YF₃.
 C. Y-1B 50 wt % Y₂O₃, 25 wt % MgF₂, 25 wt % LiF + HF (10 hrs)
 D. Y-1A " " " " (5 ")
 Both C. and D. contain ~ 90 LiF-YF₃ compound, 10 MgF₂.
 May contain a very small amount of LiF and an unid. phase.
 E. Y-4B Y₂O₃ + HF (15 hr.) at 1500°F All YF₃.
 F. Y-1F Same as C.
 G. Y-1G " "
 H. Y-1H " "
 I. Y-5A Y₂O₃ + HF. All YF₃.
 J. Y-6A 60 LiF-YF₃ phase, 30 MgF₂, 10 LiF.
 K. Y-6 80 " " " " " "
 L. Mg-1 MgF₂ from MgO + HF. All MgF₂.
 M. Mg2A " " " " " "
 N. Mg3A " " " " 95 " " 5 MgO
 O. Mg4A " " " " 95 " " 5 "
 P. Mg7A 80 LiF-YF₃ phase, 10 MgF₂, 10 LiF.

1833 BaF₂-BeF₂ Quenches (R. E. Moore)

- A. BaB95-454 E-F 560-554 All BaF₂.BeF₂
 B. " G-I 548-541 30 " " 70 BeF₂
 C. " P-S 483-465 30 " " 70 " , tr. unid.
 D. BaB 99-456 A-B 580-575 All glass
 E. " D-F 565-553
 F. " E 559 All glass
 G. BaB 99.9-457 L-Q 496-460 All BeF₂.

1834 H-NU0.5T0.5B46-1 Quench

- A. M-R 384-374 Most of the crystalline material is 7LiF.6UF₄;
 contains a small amount of unid material, probably glass
 and Q.G.

- B. U-B' 369-357 Mostly $7\text{LiF} \cdot 6\text{UF}_4$; contains a small amount of $7\text{LiF} \cdot 6\text{ThF}_4$. McVay indicates liquidus is just above 407°C .
- 1835 RbF- UF_4 Quenches
- A. H-RU25-2 D 512 50 $2\text{RbF} \cdot \text{UF}_4$, 50 unid., no $3\text{RbF} \cdot \text{UF}_4$
 - B. H-RU25-3 L-N 959-951 Good $2\text{RbF} \cdot \text{UF}_4$ and small amt. unid.
 - C. H-RU33.3-2 L-P 818-798 All $2\text{RbF} \cdot \text{UF}_4$.
 - D. H-RU41.5-1 Z-B' 593-583 70 $2\text{RbF} \cdot \text{UF}_4$, 30 $\text{RbF} \cdot 6\text{UF}_4$
- 1836 H-NZ46T3-1 Z-B' 504-496 $7\text{NaF} \cdot 6\text{ZrF}_4$, 5 ThF_4 (no appreciable cell size reduction). This quench was designed to determine the location of the maximum in the boundary curve which crosses the $7\text{NaF} \cdot 6\text{ZrF}_4$ - ThF_4 Alkemade line. R. A. Strehlow sees a slightly low index for the $7\text{NaF} \cdot 6\text{ZrF}_4$; this requires that ThF_4 contain some dissolved ZrF_4 but the effect is not discernible in the diffraction patterns for the two phases and the maximum must be very close to the Alkemade line.
- 1837 Reprocessing mixtures. J. Truitt. These samples are fused mixtures of NaF, NaBr, KI, and KCl which have been heated to 1500°F . At this temperature some NaK was introduced into the melt.
- A. SNAKA-O Sample from 1500°F liquid. The only lattice structures which appear to form the matrices for solution of other phases here are KI and NaI. 55 KI ($+0.4^\circ$ 2θ av.), 45 NaI ($+0.05$ - 0.1° 2θ av.).
 - B. SNAKA-1A Sample washed with kerosene and alcohol. Same as A.
 - C. SNAKA-2A Same as A. but also contains a small amount of free NaF.
- 1838 NaF- CrF_2 Quenches
- A. H-NCr30-1 A-D 984-977 Contains no CrF_2 or CrF_3 . Some NaF present. No clear identity of NaF- CrF_2 phases has been made. Believe both NaF- CrF_2 and NaF- CrF_3 are present here in addition to NaF.
 - B. H-NCr30-1 Z-C' 896-869 Same as A.
 - C. H-NCr30-1 Z-C' 896-869 using CoK_α . No improvement of pattern. Same identification as in A.
- 1839 LiF- UF_4 - ThF_4 slowly cooled melts F-435 H. A. Friedman.
- A. $80\text{LiF} \cdot 10\text{UF}_4 \cdot 10\text{ThF}_4$ 60 $7\text{LiF} \cdot 6\text{U}(\text{Th})\text{F}_4$, 10 $4\text{LiF} \cdot \text{UF}_4$, 10 unid., 20 LiF.
 - B. 73 " 27 " 2 " 85 $7\text{LiF} \cdot 6\text{UF}_4$, 10 LiF, 4 $\text{LiF} \cdot \text{UF}_4$.
 - C. 72 " 27 " 1 " 60 " , 40 $4\text{LiF} \cdot \text{UF}_4$.
 - D. 72 " 26 " 2 " 40 " , 60 unid., some LiF.
 - E. 72 " 25 " 3 " 95 " , 5 $4\text{LiF} \cdot \text{UF}_4$.
 - F. 72 " 24 " 4 " 90 " , trace $4\text{LiF} \cdot \text{UF}_4$, 10 LiF.
 - G. 72 " 22 " 6 " 50 " , 50 unid., some LiF.
 - H. 72 " 20 " 8 " 95 " , 5 $3\text{LiF} \cdot \text{ThF}_4$

I.	72LiF-18UF ₄ -10ThF ₄	60	7LiF.6U(Th)F ₄	40	3LiF.ThF ₄
J.	72 " 10 " 18 "	30	"	30	3LiF.Th(U)F ₄
K.	71 " 27 " 2 "	90	"	5	4LiF.UF ₄ , 5 LiF
L.	53.8" 36.2" 10 "	75	"	25	LiF.4UF ₄
M.	53.8" 23.1" 23.1"	95	"	5	LiF.2ThF ₄
N.	53.8" 10 " 36.2"	70	"	30	"
O.	40 " 50 " 10 "	30	7LiF.6UF ₄	70	LiF.4UF ₄ (enlarged -0.3° 2θ av.)
P.	40 " 30 " 30 "	70	7LiF.6U(Th)F ₄	30	LiF.4U(Th)F ₄
Q.	40 " 10 " 50 "	10	"	90	LiF.2Th(U)F ₄
R.	20 " 70 " 10 "	LiF.4UF ₄ prob. containing dissolved ThF ₄ , traces UF ₄ , or UF ₄ -ThF ₄ s.s.			
S.	20 " 40 " 40 "	All LiF.4(U,Th)F ₄			
T.	20 " 10 " 70 "	LiF.4Th(U)F ₄ ; may contain small amount of LiF.2Th(U)F ₄ .			
U.	F-367 70UF ₄ -30ThF ₄	UF ₄ -ThF ₄ s.s., apparently one phase.			
V.	" 60 " -40 "	"	"	"	"
W.	" 50 " -50 "	"	"	"	"
X.	" 40 " -60 "	"	"	"	"

1840 Service samples

- A. Deposit on outside of cell No. NM-12, S. Langer
All α Bi₂O₃.
- B. BaO. J. Schaffer. Good BaO
- C. Plug from Cu line in NaF-ZrF₄ apparatus from HF inlet
tube; formed during HF treatment. J. Schaffer.
All β 5NaF.2ZrF₄.
- D. CrCl₃ Large purple crystals. R. A. Strehlow
This flaky material produces only basal plane reflections,
as referred to ASTM 6-0535.

1841 NaF-UF₄-ThF₄ slowly-cooled melts F-481. H. A. Friedman

- A. 72NaF-8UF₄-20ThF₄. 2NaF.Th(U)F₄ s.s., trace NaF.
- B. 75 " 5 " 20 " 95 " 5 "
- C. 75 " 7 " 18 " 95 " 5 "
- D. 77 " 3 " 20 " 90 " 10 "

1842 RbF-UF₄ slowly-cooled melts F-250. H. A. Friedman

- A. 66.7 RbF-33.3 UF₄ All 2RbF.UF₄.
- B. " " Open air melt. Mostly 2RbF.UF₄;
some 3RbF.UF₄.
- C. 75 RbF-25UF₄ 90 2RbF.UF₄, 10 RbF.
C.W. RbF, 3RbF.UF₄, 2RbF.UF₄ and small
amount UO₂.
- D. " open air melt. 60 3RbF.UF₄, 20 2RbF.UF₄,
20 unid.

1843 LiF-BeF₂-ThF₄ Quenches

- A. H-LB41T15-1 B-H 750-719 (sample wet) 60 LiF.4ThF₄,
40 2LiF.BeF₂. Wet sample indicates free BeF₂ was
present.

- B. H-LB44T26-1 A-G 753-720 (sample wet) Very poor pattern.
Contains some $\text{LiF} \cdot 2\text{ThF}_4$.
- C. H-LB31T5-1 A-D 494-491 80 $\text{LiF} \cdot 2\text{ThF}_4$ (QG?), 20 $2\text{LiF} \cdot \text{BeF}_2$.
- D. " T-V 465-454 80 $\text{LiF} \cdot 2\text{ThF}_4$, 20 $2\text{LiF} \cdot \text{BeF}_2$,
possible traces $3\text{LiF} \cdot \text{ThF}_4$ s.s.
- 1844 B. J. Sturm's samples.
- A. BiF_3 (origin unknown) 50 BiF_3 , 50 unid.
- B. No. YY NiF_2 . Rocky Mt. Research Co. Good NiF_2 .
- C. No. UZ $3\text{KF} \cdot \text{VF}_3$ from $(\text{NH}_4)_3\text{VF}_6$ + KF solutions. Used as tentative standard for $3\text{KF} \cdot \text{UF}_3$.
- D. No. TZ $(\text{NH}_4)_3\text{VF}_6$ from V_2O_5 + NH_4HF_2 . 90 $(\text{NH}_4)_3\text{VF}_6$ (ASTM),
10 NH_4HF_2 .
- 1845 H-NZ42U3.7T7.5 J-N 617-603 Principally $7\text{NaF} \cdot 6\text{ZrF}_4$ containing both the UF_4 and ZrF_4 .
- 1846 $\text{NaF} \cdot \text{LiF} \cdot \text{BeF}_2$ Quenches
- A. NB65L10-460 A-E 324-315 BeF_2 and QG.
- B. " F-J 310-295 BeF_2 and trace $\text{NaF} \cdot \text{BeF}_2$.
- C. " K-N 292-281 80 BeF_2 , 20 $\text{NaF} \cdot \text{BeF}_2$.
- D. " O-Q 278-270 70 BeF_2 , 20 $\text{NaF} \cdot \text{BeF}_2$,
10 $2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$
- E. " R-T 267-261 70 BeF_2 , 20 $\text{NaF} \cdot \text{BeF}_2$,
10 $2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$.
- F. NB65L15-461 A-E 325-314 BeF_2
- G. " F-J 311-298 BeF_2 and trace $\text{NaF} \cdot \text{BeF}_2$.
- H. " K-O 294-281 All BeF_2 .
- I. " P-U 277-261 70 BeF_2 , 20 $2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$,
10 $\text{NaF} \cdot \text{BeF}_2$.
- J. NB65L20-462 A-C 324-318 All BeF_2
- K. " K 292 "
- L. " N 283 "
- M. " R 267 80 BeF_2 , 20 $2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$
- N. " S-T 264-261 70 BeF_2 , 10 $2\text{NaF} \cdot 2\text{LiF} \cdot 3\text{BeF}_2$,
20 $\text{NaF} \cdot \text{BeF}_2$.
- 1847 H-NU80B0.1 Z-547 95 UF_4 , 5 $\text{NaF} \cdot 2\text{UF}_4$
This BeF_2 containing quench was designed to attempt to corroborate the Mound Laboratory's report of a phase having the formula $\text{NaF} \cdot 4\text{UF}_4$. Presence of small amount of BeF_2 was expected to provide a liquid for reaction medium.
- 1848 SnF_2 samples
- A. B and A. Code 2983 Lot M139
- B. Mackay 1st melt
- C. Mackay 2nd melt
- D. City Chemical Batch 4-2-L4
A-C identical, good SnF_2 . D. appears to be a polymorph resembling A-C, two phases, or SnF_2 pptd. under such conditions as to produce a different set of relative intensities from those usually observed.

1849 RbF-UF₄ Quenches

- A. F-250 70 RbF-30 UF₄ beginning material. Largely 2RbF·UF₄; traces 3RbF·UF₄.
- B. H-RU30-1 A-D 451-441 Largely 2RbF·UF₄; possible traces 3RbF·UF₄.
- C. H-RU30-2 A-D 960-950 2RbF·UF₄; trace unidentified.
- D. H-RU30-2 W-Y 827-813 " " " " , or 3RbF·UF₄.

1850 LiF-UF₄-ThF₄ Quenches

- A. H-LULOT70-1 B-D 1004-999 All LiF·4U(Th)F₄ s.s. X-ray does not look like single phase material but McVay sees only single phase.
- B. H-LULOT70-1 X-Y 906-900 75 LiF·4U(Th)F₄, 20 LiF·2ThF₄, 5 ThF₄.
- C. " A'-B' 885-878 Same as A.
- D. H-LU36.2T10-1 H-J 722-710
- E. " K-M 705-695
- F. " N-P 690-679
- D.-F. identical, 90 LiF·4U(Th)F₄, 10 unid., possible traces LiF·2ThF₄.

1851 Service Samples

- A. Er₂O₃. Good Er₂O₃ pattern. Contains traces of Er(OH)₃.
- B. ErO₃ No. 48. Mostly ErCl₃·6H₂O
- C. NiCl₂ charge bottle residue. 90 NiCl₂-10 unid.
- D. ErO₃ no. 43 (fused). Hydration occurred during handling
- E. Er₂O₃ No. 47D. All Er₂O₃
- F. Charge bottle residue containing Sm. This material is unidentified by ASTM patterns for Sm compounds.
- G. MoO₃. This material is probably very good MoO₃. Its flakiness produces preferred orientation effects.

1852 NaF-LiF-BeF₂ Quenches. R. E. Moore

- A. NB60L20-472 A-F 295-284 All BeF₂
- B. " G 281-308 "
- C. " H 278-305 BeF₂ and QG(?)
- D. " I 275-301 " " "
- E. " L 265-290 80 NaF·LiF·3BeF₂, 20 BeF₂
- F. " O 254-278 NaF·LiF·BeF₂ and BeF₂
- G. " P 251-275 BeF₂; probably contains some very poorly crystallized 2LiF·BeF₂.
- H. NB60L20-472 R 244-267 BeF₂; probably contains some very poorly crystallized 2LiF·BeF₂.
If the 27.7° 2θ line is shared by the two compounds NaF·LiF·3BeF₂ and BeF₂, the above samples contain much less BeF₂ than a first estimate would indicate.
- I. NB60L20-471 281-278. If the 27.7° 2θ line is shared, this sample contains only NaF·LiF·2BeF₂.

In this series, the higher temperature indicates the first temperature at which the series was held in order to make more readily possible the formation of NaF.LiF.3BeF_2 .

- J. NB60L20-473 A-E 387-375 All glass
- K. " G-I 367-358 "
- L. NB70L10-464 O 277 Practically all BeF_2 . Contains a small amount of other material present; resembles NaF.LiF.3BeF_2 but is not positively identified as that phase.
- M. NB70L10-464 P 273 BeF_2 and glass
- N. " R 266 90 BeF_2 , 10 NaF.LiF.3BeF_2
- O. " T 260 85 BeF_2 , 10 NaF.BeF_2 , 5 NaF.LiF.3BeF_2

1853 $\text{LiF-UF}_4\text{-ThF}_4$ slowly cooled melts. (H. A. Friedman)

- A. F-473 53.8 LiF -16.2 UF_4 -30 ThF_4 . 80 $7\text{LiF.6UF}_4\text{-7LiF.6ThF}_4$ (no separation of major peaks, probably single phase solid solution), 20 LiF.2ThF_4 .
- B. F-439. 68 LiF -8 UF_4 -24 ThF_4 . 80 3LiF.ThF_4 , 10 LiF.2ThF_4 (probably contains some dissolved UF_4), 10 7LiF.6U(Th)F_4 .
- C. F-439. 74 LiF -6 UF_4 -20 ThF_4 . Practically all 3LiF.ThF_4 ; may contain traces LiF.2ThF_4 .
- D. F-435 33.3 LiF -33.3 UF_4 -33.3 ThF_4 . Practically all $\text{LiF.4UF}_4\text{-LiF.4ThF}_4$ solid solution. Traces $\text{UF}_4\text{-ThF}_4$ s.s.
- E. F-436 20 LiF -60 UF_4 -20 ThF_4 . Practically all LiF.4UF_4 containing some ThF_4 content. Traces UF_4 .
- F. F-436 20 LiF -30 UF_4 -50 ThF_4 . Practically all LiF.4ThF_4 . Possible traces unid. material.
- G. F-436 20 LiF -20 UF_4 -60 ThF_4 . LiF.4(U,Th)F_4
- H. F-436 20 LiF -50 UF_4 -30 ThF_4 . "
- I. F-436 20 LiF -30 UF_4 -50 ThF_4 . "
- J. F-437 40 LiF -40 UF_4 -20 ThF_4 . 40 7LiF.6(U,Th)F_4 ,
60 LiF.4(U,Th)F_4 .
- K. F-435 53.8 LiF -31.2 UF_4 -15 ThF_4 . 70 7LiF.6(U,Th)F_4 ,
30 LiF.4(U,Th)F_4 .
- L. F-439 60 LiF -10 UF_4 -30 ThF_4 . 70 7LiF.6(U,Th)F_4 , 30 3LiF.ThF_4
- M. F-439 62 " -10 " -28 " 70 " 30 "

1854 Service samples

- A. C-30 E.E. 3451 tube plug (Hyland) Well crystallized 7NaF.6(Zr,U)F_4 . No apparent segregation of the solid solution. Possible trace 3NaF.4ZrF_4 .
- B. Bubbler tube tip. C-45. N. V. Smith. 50 3NaF.ZrF_4 , 50 ZrO_2 . It is inferred from this analysis that oxide formation occurred at this tip rather than that the tip was a cold spot for the collection of dispersed ZrO_2 .
- C. C-128 E.E.3352. 80 3LiF.ThF_4 , 20 LiF.2ThF_4 . (10-21-57) At the time of issuance of this memo it appears likely that 7LiF.6ThF_4 decomposes at $<450^\circ\text{C}$ into 3LiF.ThF_4 and LiF.2ThF_4 .

- D. C-126 E.E.1214 60 2LiF.BeF₂, 30 LiF.BeF₂, 20 unid.
 E. C-84 E.E.1212 70 2NaF.LiF.2BeF₂, 30 2LiF.BeF₂
 F. C-127 E.E.1211 60 2LiF.BeF₂, 40 LiF.2ThF₄
 G. No. 3370 (Doss) 60 7NaF.6ZrF₄-3 NaF.2ZrF₄ s.s.
 (41% ZrF₄), 40 β_2 2NaF.ZrF₄
 H. Condensate in riser tube cap using C-45 (N. V. Smith)
 All ZrF₄.
 I. Riser tube plug (N. V. Smith) All ZrF₄.
 J. Y-8A. YF₃ from Y₂O₃ + HF. All YF₃
 K. Mg-6 MgF₂ from MgO + HF. All MgF₂.
 L. No. 3453. 95 ZrO₂, 5 unid.

1855 LiF-BeF₂-ThF₄ quenches

- A. H-LB5.5 T26-1 X-Z 451-445 Practically all 3LiF.ThF₄
 slight cell size reduction
 B. H-LB5.5T26-1 R-U 475-457 60 3LiF.ThF₄, 40 7LiF.6Th(U)F₄
 C. H-LB27T5-1 V-W 431-429 60 " , 40 2LiF.BeF₂

1856 NaF-LiF-BeF₂ quenches

- A. NB70L15-465 M-N 284-280 Mostly BeF₂, traces 2LiF.BeF₂
 B. " O-Q 276-273 60 BeF₂, 40 NaF.LiF.3BeF₂.
 C. " S-T 263-260 70 " 20 " ,
 10 2LiF.BeF₂.
 D. NB70L20-466 M-N 285-281 BeF₂ and quench growth
 E. " P-Q 273-270 70 BeF₂, 30 NaF.LiF.3BeF₂.
 F. " T 260 Largely BeF₂, small amount
 NaF.LiF.3BeF₂ and 2LiF.BeF₂ present.

1857 NaF-ThF₄ slowly cooled melts (H. A. Friedman) F-356

- A. 78 NaF-22 ThF₄ 90 2NaF.ThF₄, 10 NaF
 B. 76 " 24 " 95 " 5 "
 C. 60 " 40 " 40 NaF.ThF₄, 60 2NaF.ThF₄
 D. 66.7" 33.3" All 2NaF.ThF₄ (apparently isostructural
 with β_2 2NaF.UF₄)
 E. 66.7" 33.3" Open air melt 90 2NaF.ThF₄, isostruc-
 tural with β_3 2NaF.UF₄, 10 β_2 2NaF.ThF₄.

1858 3RbF.UF₄ stability studies

- A. 3RbF.UF₄ slowly cooled melt. This melt was treated with
 HF during preparation. Best pattern of 3RbF.UF₄ to date.
 B. 3RbF.UF₄ (from A) open air melt. 3RbF.UF₄ does not pro-
 duce another crystal type when heated in open air. All
 cubic 3RbF.UF₄ as in A.
 C. F-372 15 KF-60 RbF-25 UF₄ All 3(Rb,K)F.UF₄
 D. F-372 45 " 30 " 25 " 95 3(Rb,K)F₃.UF₄, 5 unid.
 E. F-372 30 " 45 " 25 " 95 " 5 "
 F. F-372 60 KF-15 RbF-25 UF₄ 80 3Rb(K)F.UF₄ and 3K(Rb)F.UF₄,
 20 unid.
 G. F-250 2RbF.UF₄ Treated with HF during melting. All
 2RbF.UF₄.

1859 B-BC10-152 D-F 443-437 (90 BeF₂-10 CeF₃). 80 BeF₂, 20 CeF₃.

1860 Materials for Harris' crystal structure determinations.

- A. F-314 75 NaF-25 ZrF₄
- B. F-119 58 NaF-42 ZrF₄
- C. 3NaF.HfF₄ from H-NHf25-1
- D. F-119 66.7 NaF-33.3 ZrF₄
- E. H-LU46.2-1 S-T 600-594

Each of these samples provided good enough quality of material to use in structure determinations.

1861 NaF-ThF₄-UF₄ quenches

1. H-NU3T20-1 J-K 616-612 4NaF.ThF₄
2. " O-R 595-583 95 β 3NaF.UF₄, 5 β₂ 2NaF.ThF₄
Apparently β 3NaF.UF₄ permits an extensive ThF₄ substitution although no NaF-ThF₄ analog has been observed in these experiments. Thus the phase β 3NaF.UF₄ above is β 3NaF.(U,Th)F₄.
3. H-NU3T20-1 Y-B' 552-539 60 β₂ 2NaF.ThF₄ (contains some dissolved U), 40 β 3NaF.UF₄ (contains some dissolved Th)
4. H-NU5T16-2 E-F 620-616 90 β 3NaF.UF₄ (sl. enlarged cell),
10 4NaF.ThF₄.
5. " U-W 555-546 " " "
6. " X 541 " " 10 β₂ 2NaF.ThF₄,
trace 4NaF.ThF₄.
7. H-NU5T20-1 O-S 597-579 90 β 3NaF.UF₄-4NaF.ThF₄ s.s.,
10 β₂ 2NaF.ThF₄.
8. H-NU5T28¹/₂-2 L-O 679-659 All β₂ 2NaF.Th(U)F₄
9. H-NU10T23.3-1 623-613 " " "
10. H-NU15T8-3 J-M 601-587 90 β 3NaF.UF₄-4NaF.ThF₄ s.s.,
10 β₂ 2NaF.ThF₄ and α 3NaF.UF₄.
11. " S-W 561-543 40 β 3NaF.UF₄-4NaF.ThF₄ s.s.,
40 β₂ 2NaF.ThF₄, 20 β₃ 2NaF.UF₄
12. H-NU15T35-1 J-L 723-708 60 7NaF.6UF₄ (enlarged cell),
40 NaF.2ThF₄.
13. H-NU15T18¹/₂-1M-P All β₃ 2NaF.UF₄
14. H-NU15T8-3 G-I 611-604 80 β 3NaF.UF₄, 10 β₂ 2NaF.ThF₄,
10 unid.
15. H-NU18¹/₂T15-1L 580 90 β₃ 2NaF.U(Th)F₄, 10 β₂ 2NaF.ThF₄
16. " P-R 646-639 All β₃ 2NaF.U(Th)F₄
17. " -2A-B 608-605 "
18. " -2X-Z 474-465 80 β₂ 2NaF.ThF₄, 20 β 3NaF.UF₄
19. H-NU20T4-2 G-H 604-596 60 α 3NaF.UF₄, 40 β 3NaF.UF₄-
4NaF.ThF₄ s.s.
20. " M-P 560-540 30 β₃ 2NaF.UF₄, 30 β₂ 2NaF.ThF₄,
40 β 3NaF.UF₄-4NaF.ThF₄ s.s.
21. " R-U 529-506 80 β 3NaF.UF₄, 20 β₃ 2NaF.UF₄.
22. " X-Z 490-478 90 β₃ 2NaF.UF₄, 10 NaF.
23. H-NU22T11.5-2 X-Z 474-465 90 β₃ 2NaF.U(Th)F₄,
10 β₂ 2NaF.ThF₄.

24. H-NU28¹/₂T5-2 A-C 608-601 All β_3 2NaF.UF₄
 25. " R-V 639-609 "
 26. H-NU30T10-1 D' 631 60 β_3 2NaF.UF₄, 40 7NaF.6UF₄
 27. H-NU32T5-1 S-V 656-640 All 5NaF.3UF₄
 28. " Y-B' 625-610 60 β_3 2NaF.UF₄, 40 7NaF.6UF₄
 29. H-NU36.2T10-1 U-Y 637-607 90 7NaF.6UF₄, 10 NaF.ThF₄
 30. H-NU18¹/₂ T15-2 X-Z 474-465 80 β_2 2NaF.ThF₄, 20 β_3 2NaF.UF₄
 31. H-NU22T11¹/₂-2 X-Z 474-465 20 " , 80 "
 32. H-NU30T20-1 P-R 693-685 60 5NaF.3UF₄, 40 7NaF.6UF₄
 33. " Y-B' 656-642 50 " , 30 " , 20 β_3 2NaF.UF₄.
 34. H-NU34T5-1 O-Q 676-665 95 " , 5 NaF.ThF₄
 35. " Z-D' 618-597 60 β_3 2NaF.UF₄, 40 7NaF.6UF₄
 36. H-NU10T40-1 I-N 759-744 30 NaF.ThF₄, 70 NaF.2ThF₄
 37. H-NU37TJ-1 V-Y 663-650 70 7NaF.6UF₄, 30 5NaF.3UF₄
 38. " P-S 689-676 60 " , 40 "
 39. H-NU7T18-1 F-I 641-639 All poorly crystallized 4NaF.ThF₄
 40. " T-X 633-631 70 4NaF.ThF₄, 30 β_2 2NaF.ThF₄
 41. H-NU8T20-1 P-S 591-578 80 β_2 2NaF.ThF₄, 10 4NaF.ThF₄,
 10 unid.
 42. H-NU10T40-1 W-Y 208-699 80 7NaF.6UF₄ (enlarged cell size),
 20 NaF.2ThF₄
 43. H-NU15T35-1 M-P 701-679 60 7NaF.6UF₄, 40 NaF.2ThF₄
 44. H-NU5T37-1 M-O 693-687 70 3NaF.2ThF₄ (enlarged cell)
 30 7NaF.6UF₄ (enlarged cell)

1862 YF₃ production samples G. Nessel

- A. Y-9(2) Good YF₃
 B. Y-10 95 YF₃, 5 unid.
 C. Y-11B Good YF₃
 D. Y-12 95 YF₃, 5 unid.
 E. Y-13 " "
 F. Y-14 Good YF₃
 G. Y-15 " "

1863 NaF-HfF₄ quenches

- A. H-NHf35-1 B-595 90 β_4 2NaF.HfF₄, 10 β_2 or β_3 2NaF.HfF₄
 B. H-NHf33.3-3 X-Y 674-665 All β_4 2NaF.HfF₄
 C. H-NHf31-1 X-Z 549-537 40 β_4 2NaF.HfF₄, 30 α 5NaF.2HfF₄,
 30 β 5NaF.2HfF₄
 D. H-NHf28.2-3 A-C 609-602 All α 5NaF.2HfF₄
 E. " D-I 597-574 65 " , 30 β_3 2NaF.HfF₄,
 5 β_4 2NaF.HfF₄.
 F. " J-L 569-558 Same as E.
 G. " M-N 553-548 "
 H. " O-P 543-538 "
 I. " Q-S 533-523 50 β 5NaF.2HfF₄, 40 β_3 2NaF.HfF₄,
 10 β_4 2NaF.HfF₄
 J. " Y-Z 494-489 Same as I.

- K. H-NHf35-3 W-Y 422-413 70 β_3 2NaF.HfF₄, 20 7NaF.6HfF₄,
10 β 5NaF.2HfF₄
L. H-NHf31-3 α - β 511-505 70 β_3 2NaF.HfF₄, 30 β 5NaF.2HfF₄

1864 NaF-ThF₄ quenches

- A. H-NT20-3 A-C 661-652 Unid. Probably all quench growth
B. " E 643 90 unid., 10 4NaF.ThF₄
C. " F-H 639-628 Same as A.
D. " I-K 624-613 "
E. " M 602 90 4NaF.ThF₄, 10 unid.
F. " Q-S 581-571 85 " , 10 NaF, 5 β_2 2NaF.ThF₄
G. " T-W 565-550 70 β_2 2NaF.ThF₄, 20 NaF,
10 4NaF.ThF₄.
H. " N-P 597-587 All 4NaF.ThF₄.
I. H-NT20-1 O-Q 616-592 "
J. " M-N 640-628 70 4NaF.ThF₄, 40 unid.
K. H-NT20-2 G-H 624-616 90 4NaF.ThF₄, 20 unid.
L. H-NT235-1 G 612 90 4NaF.ThF₄, 10 β_2 2NaF.ThF₄.
M. H-NT24-1 L-M 613-608 90 " , 10 "

1865 Service samples

- A. A-1 LiF-MgF₂-YF₃ (Nessle) 60 LiF-YF₃ compound, 20 MgF₂,
20 LiF.
B. A-2 " " 70 LiF-YF₃ compound, 20 MgF₂,
10 LiF.
C. A-4 " " 80 LiF-YF₃ compound, 5 MgF₂,
15 LiF.
D. A-4 heated in open air. Contains no Y₂O₃.
E. Y₂O₃ (Nessle). Good Y₂O₃.
F. MgF₂ from MgO + HF (Nessle). 90 MgF₂, 10 unid.

1866 NaF-ThF₄ quenches

- A. H-NT40-1 E-F 712-707 Very poorly crystallized 3NaF.2ThF₄
B. " H-I 694-688 All 3NaF.2ThF₄
C. " J-L 682-670 30 NaF.ThF₄, 50 2NaF.ThF₄,
20 3NaF.2ThF₄
D. H-NT39-2 I 696 All 3NaF.2ThF₄
E. " J 690 90 " , 10 2NaF.ThF₄
F. " K 684 70 2NaF.ThF₄, 30 NaF.ThF₄, possible
traces 3NaF.2ThF₄.
G. H-NT41-2 I-J 696-690 95 3NaF.2ThF₄, 5 NaF.ThF₄
H. " K-L 684-677 Trace " , 60 2NaF.ThF₄,
40 NaF.ThF₄

1867 NaF-LiF-BeF₂ quenches

- A. M-NB54L30-475 J-M 288-252 30 NaF.BeF₂, 30 2LiF.BeF₂,
30 NaF.LiF.3BeF₂, 10 BeF₂.
B. " O-N 276-272 50 2LiF.BeF₂, 50 NaF.LiF.3BeF₂.
C. M-NB57L13-477 P-T 266-253 60 NaF.BeF₂, 20 2LiF.BeF₂,
10 NaF.LiF.3BeF₂, 10 BeF₂.

- D. M-NB60L20-479 J 280 50 NaF.LiF.3BeF₂, 50 BeF₂.
 E. " N-P 275-270 50 NaF.LiF.3BeF₂, 50 BeF₂
 F. " S 263 30 " 70 "
 G. " T 262 BeF₂ and unid. material, too poorly crystallized to analyze, probably unreacted material.
- 1868 H-LU10T36.2-2 K-M 622-611 80 LiF.2ThF₄, 20 3LiF.ThF₄
- 1869 Service samples
 A. N-50 CrF₂ + C-45 No 62. C. M. Blood 90 7NaF.6ZrF₄, 10 NaF.CrF₂.2ZrF₄
 B. No. 3458 C-30 Doss. 60 7NaF.6Zr(U)F₄, 40 Fe.
 C. No. 3454 C-30 Top of sample, covered with metallic appearing scale. Contains ZrO₂ and unid. material which looks cubic and metallic. Possibly contains Pb₂O₃.
- 1870 Samples from W. T. Ward
 A. BW47-1 713° filtrate. 70 LiF.BeF₂, 30 CeF₃
 B. BW46-1 716° filtrate. All unidentified material
 C. BW47-3 517° filtrate. 90-95 LiF.BeF₂, 5-10 CeF₃.
- 1871 NaF-ZrF₄-ThF₄ quenches
 These quenches were examined in attempt to determine whether the Alkemade line 7NaF.6ZrF₄-ThF₄ is quasi-binary or not.
 A. H-NZ47T3-1 Y-Z 501-500 >95 7NaF.6ThF₄. It is not clearly evident whether the small amount of ThF₄ present contains dissolved ZrF₄ or not.
 B. H-NZ45T4-1 D' 510 95 7NaF.6ZrF₄, 5 ThF₄. No clear indication that ZrF₄ contains dissolved ThF₄.
- 1872 Service samples
 A. No. 3370 (Doss) 90 β₂ 2NaF.ZrF₄, 10 7NaF.6ZrF₄, trace ZrO₂
 B. No. 3502 " C-100. 60 LiF, 40 NaF
 C. No. E.E.1281 " C-12 Contains KF, LiF, and NaF, and a few unidentified lines; these may be higher order reflections from the alkali fluorides.
 D. No. 3376 (Doss) C-122 70 7NaF.6ZrF₄-30 3NaF.ZrF₄
 E. No. 3305 " C-44 60 3NaF.2ZrF₄, 40 β₂ 2NaF.ZrF₄.
 No evidence of U containing phase.
 F. Mg-8 MgF₂ from MgO + HF (Nessle). All MgF₂.
 G. Metallic deposit from NiF₂ reduction in C-12 (Doss) All NiF₂.
 H. E-I VPP XX-1 Scale from 347 stainless steel (J. E. Bigelow) All NiF₂.
 I. Mg-11 95 MgF₂, 5 MgO
 J. Mg-13 70 MgO, 30 MgF₂
 K. Mg-15 >95 MgF₂, traces MgO
 L. Mg-16 90-95 MgF₂, 5-10 MgO.

1873 Production batches (Doss-Blakely)

- A. No. 3392 C-128 80 $3\text{LiF} \cdot \text{ThF}_4$, 20 $\text{LiF} \cdot 2\text{ThF}_4$
 B. E.E.1212 C-84. 70 $2\text{NaF} \cdot \text{LiF} \cdot 2\text{BeF}_2$, 30 $2\text{LiF} \cdot \text{BeF}_2$.
 C. E.E.1214 C-126. 90 $2\text{LiF} \cdot \text{BeF}_2$, 10 $\text{LiF} \cdot 4\text{UF}_4$. These are not the equilibrium products of crystallization according to the $\text{LiF}-\text{BeF}_2-\text{UF}_4$ phase diagram.
 D. E.E. 1218 $62\text{LiF}-37\text{BeF}_2-1\text{UF}_4$ 90 $2\text{LiF} \cdot \text{BeF}_2$, 10 $\text{LiF} \cdot 4\text{UF}_4$. These are not equilibrium products of crystallization.
 E. E.E.1219 C-84 Same as B.
 F. E.E.1222 C-123 80 $\text{NaF} \cdot \text{BeF}_2$, 20 β $2\text{NaF} \cdot \text{BeF}_2$, 10 $7\text{NaF} \cdot 6\text{UF}_4$.
 G. E.E.1223 C-126 Same as C.
 H. E.E.1224 C-35 50 $\text{NaF} \cdot \text{BeF}_2$, 50 unidentified material.
 I. E.E.1228 C-125 90 $\text{NaF} \cdot \text{BeF}_2$, 10 $\text{NaF} \cdot \text{ThF}_4$ (containing dissolved U)
 J. E.E.1229 C-127 80 $\text{LiF} \cdot 2\text{ThF}_4$, 20 $2\text{LiF} \cdot \text{BeF}_2$.
 K. E.E.1230 C-84 Same as C.
 L. E.E.1231 C-130 90 $2\text{LiF} \cdot \text{BeF}_2$, 10 $\text{LiF} \cdot 4\text{UF}_4$.
 M. E.E.1232 C-130 80 " , 20 "
 N. ThO_2 (L. Harris) Good ThO_2 .

1874 H-UT40-2 X-Z 927-912 Appears to be single phase material, UF_4 containing small amount of ThF_4 . ThF_4 content of solid solution scarcely changes cell parameters of UF_4 .

1875 $\text{NaF}-\text{UF}_4-\text{ThF}_4$ quenches

- A. H-NU2T18-1 Y-Z 553-543 70 $4\text{NaF} \cdot \text{ThF}_4$, 30 β_2 $2\text{NaF} \cdot \text{ThF}_4$
 B. H-NU2T20-1 U 620 90 " , 10 "
 C. " V-W 614-608 All " , "
 D. H-NU2T22-1 Q-Q 608-595 90 " , 10 "
 E. " X-Z 553-543 90 " , 10 "
 F. H-NU2T24-1 N-P 614-602 70 " , 30 "
 G. " X-Z 553-543 70 " , 30 "

1876 $\text{LiF}-\text{BeF}_2-\text{ThF}_4$ quenches

- A. H-LB27T5-2 X-A' 454-440 80 $3\text{LiF} \cdot \text{ThF}_4$ (reduced cell size), 20 $\text{LiF} \cdot \text{BeF}_2$.
 B. H-LB7T20-1 X-Z 454-444 All $3\text{LiF} \cdot \text{ThF}_4$ with marked reduction in cell size.
 C. H-LB7.5T23-1 X-Z 454-444 Same as B.

1877 $\text{BeF}_2-\text{CeF}_3$ quenches

- A. J-BC25-1 A-D 446-441 90 CeF_3 , 10 BeF_2 . Most of the BeF_2 must be glass.
 B. J-BC25-1 Q-T 406-396 Same as A.
 C. J-BC33.3-2 A-D 447-442 95 CeF_3 , 5 BeF_2 .
 D. J-BC33.3-2 P-S 409-397 All CeF_3 ; BeF_2 must be present as glass.

1878 Sample E-1-WS (Blakely) Green flake material from surface of C-31. 60 UF_4-ZrF_4 solid solution, 40 unid.

1879 LiF-UF₄-ThF₄ Quenches

A.	H-LU20T8-1	S-T 507-504	80	3LiF.ThF ₄ ss, 20	7LiF.6U(Th)F ₄
B.	H-LU22T6-1	J-L 488-481	95	7LiF.6UF ₄ , 5LiF, trace	4LiF.UF ₄
C.	H-LU24T4-1	N 475	95	"	, 5 "
D.	H-LU26T2-1	H-I 494-481	45	3LiF.ThF ₄ s.s., 45	7LiF.6UF ₄ , 10 4LiF.UF ₄ .
E.	H-LU26T2-1	J 487	90	7LiF.6UF ₄ , 10	LiF
F.	"	L 481	"	"	" "
G.	"	M 478	"	"	" "
H.	"	N 475	"	"	" "
I.	"	O 472	"	"	" "
J.	"	R 464	"	"	" "

1880 LiF-BeF₂-ThF₄ quenches

A.	H-LB26T7-1	W-Z 422-413	70	3LiF.ThF ₄ s.s., 30	2LiF.BeF ₂
B.	H-LB27T7-1	V-Z 419-413	70	"	, 30 "
C.	H-LB28T6-1	X-Z 407-398	70	"	, 30 "
D.	H-LB28T7-1	M-O 446-437	80	"	, 20 "
E.	H-LB29T5-1	X-Z 419-413	80	"	, 20 "
F.	H-LB29T6-1	O-Q 431-427	80	"	, 20 "
G.	H-LB29T6-1	X-Z 419-413	70	"	, 30 "
H.	H-LB29T7-1	Q-S 427-418	80	"	, 20 "
I.	H-LB29T7-1	X-Z 401-395	70	"	, 30 "
J.	H-LB31T5-2	M-O 428-420	70	"	, 30 "
K.	H-LB31T5-2	X-Z 389-383	70	"	, 25 "

5 LiF.2ThF₄.

1881 NaF-ThF₄-UF₄ quenches

A.	H-NU7T26 ₃ -1	L-N 675-664	90	β ₂ 2NaF.ThF ₄ , 10	β ₃ 2NaF. (U,Th)F ₄
B.	"	O-Q 658-645	All	β ₂ 2NaF.ThF ₄	
C.	H-NU14T47-1	E-I 824-810	80	NaF.2ThF ₄ , 20	(U,Th)F ₄
D.	"	X-Z 674-654	80	"	, 20 7NaF.6U(Th)F ₄
E.	H-NU40T20-1	M-P 743-718	60	7NaF.6UF ₄ , 40	Th(U)F ₄
F.	"	S-U 689-670	40	"	, 60 NaF.2UF ₄ , trace ThF ₄ .
G.	H-NU45T10-1	K-L 701-693	80	"	, 20 UF ₄ possible trace NaF.2UF ₄
H.	"	O-Q 669-653	60	"	, 40 NaF.2UF ₄
I.	H-NU45T15-1	O-Q 727-708	50	"	, 50 ThF ₄
J.	"	S-U 689-670	45	"	, 55 NaF.2UF ₄
K.	H-NU50T5-1	M-O 685-669	80	"	, 10 " , 10 UF ₄

1882 Service samples

A.	Mg-10 (Truitt)	85 MgF ₂ , 15 MgO
B.	Mg-17	>95 MgF ₂ , <5 MgO
C.	CrF ₂ + CrF ₃ (R. A. Strehlow)	50 CrF ₃ , 50 Cr ₂ O ₃ , no CrF ₂ .
D.	FeF ₂ .XH ₂ O (B. J. Sturm)	All 2FeF ₃ .9H ₂ O

1883 LiF-ThF₄ quenches

Phase studies in the system LiF-BeF₂-ThF₄ suggest that 7LiF.6ThF₄ has a lower limit of stability. These are initial samples pursuant to that determination.

- A. H-LT30-1 O-S 537-502 80 3LiF.ThF₄, 20 7LiF.6ThF₄
 B. H-Cl28-1 Y-Z 519-514 90 " , 10 "
 C. H-LT46.2-2 O-Q 557-538 10 " , 90 "

1884 Service samples (P. Blakely)

- A. Sludge from bottom of reactor pot. Sample No. 3471 C-130.
 60 UO₂, 40 2LiF.BeF₂, no UF₄ containing material.
 B. Be-1 Same as A.
 C. Be-2 70 UO₂, 30 2LiF.BeF₂.

1885 NaF-RbF-UF₄ mixtures

- A. F-361 31 RbF-46 NaF-23 UF₄ 70 NaF.RbF.UF₄, 20 2RbF.UF₄,
 10 NaF.
 B. F-265 26.9 RbF-26.9 NaF-46.2 UF₄ 60 7RbF.6UF₄ s.s.,
 40 7NaF.6UF₄ s.s.
 C. H-NR8U27-1 R-T 499-484 20 NaF.RbF.UF₄, 40 β₃ 2NaF.UF₄,
 40 β 3NaF.UF₄.
 D. " X-Z 466-457 40 NaF.RbF.UF₄, 50 β₃ 2NaF.UF₄,
 10 NaF.
 E. H-NR41.5U38.5-1 J-K 540-534 40 NaF.RbF.UF₄,
 30 β₃ 2NaF.UF₄, 30 2RbF.UF₄.
 F. H-NR41.5U38.5-1 O-Q 512-500 60 NaF.RbF.UF₄, 40 7RbF.6UF₄
 G. H-NR8U27-1 O-Q 512-506 80 β₃ 2NaF.UF₄, 20 β 3NaF.UF₄
 H. H-NR46U23-1 F-H 563-538 95 3RbF.UF₄, 5NaF.
 I. H-NR46U23-1 U-W 479-470 80 NaF.RbF.UF₄, 20 3RbF.UF₄.

1886 Service samples.

- A. RS5010 63 LiF-37 BeF₂ + 3 wt % FeF₂. All 2LiF.BeF₂.
 B. N-50 C-45 CrF₂ No. 1 Samples No. 8 (C. M. Blood).
 Mostly 7NaF.6ZrF₄. Small but identifiable amounts of
 NaF.CrF₂.2ZrF₄ and NaF.ZrF₄.
 C. N-50 C-45 CrF₂ No. 1 Sample No. 88 45 β₂ 2NaF.ZrF₄,
 45 NaF.CrF₂.2ZrF₄, 10 7NaF.6ZrF₄-3NaF.2ZrF₄ s.s.

1887 H-LU16.2T30-1 V-X 630-623 50 LiF.2ThF₄, 20 3LiF.ThF₄,
 30 7LiF.6ThF₄.

1888 Production batch samples (J. Truitt)

- A. Y-16 All YF₃
 B. Y-17 90 YF₃, 10 unid. (not Y₂O₃ or YOF)
 C. Y-18 90 YF₃, 10 unid.

1889 RbF-UF₄ Quenches

These experiments were planned to check on the possible low temperature inversion or decomposition (on cooling) of 3RbF·UF₄.

A. H-RU25-6 A 482 (yellow) All unidentified material. The diffraction pattern for this single phase material (C. Weaver) closely resembles that of tetragonal 3KF·UF₄; has appreciably larger cell-size.

B. H-RU25-6 B 480 (yellow) Same as A, but shows in addition, a small amount of 2RbF·UF₄.

C. H-RU25-6 C-D 478-476 70 2RbF·UF₄, 20 phase resembling tetragonal 3KF·UF₄, referred to hereafter as tetragonal 3RbF·UF₄.

D. H-RU25-6 E-F 474-472 70 2RbF·UF₄, 30 tetrag. 3RbF·UF₄, trace RbF.

E. H-RU25-6 X-Y 405-400 Same as D.

1890 LiF·BeF₂-ThF₄ quenches

A.	H-LB29T5-2	W-Y 384-378	80	3LiF·ThF ₄ s.s.,	20	2LiF·BeF ₂ .
B.	H-LB29T6-2	D-F 442-436	80	"	20	"
C.	"	M-O 409-399	70	"	20	"
					10 unid.	
D.	H-LB27T7-2	B-C 450-446	80	"	20	2LiF·BeF ₂ , trace LiF·2ThF ₄ .
E.	"	R-S 384-380	70	"	20	2LiF·BeF ₂ , 10 unid.
F.	H-LB29T7-2	E-G 438-431	80	"	20	2LiF·BeF ₂ , trace LiF·2ThF ₄ .
G.	"	I-K 424-416	80	"	20	2LiF·BeF ₂ , trace LiF·2ThF ₄ .
H.	H-LB35T7-3	D-F 466-459	All	LiF·2ThF ₄ ; probably contains some glass or QG.		
I.	"	P-R 412-404	80	LiF·2ThF ₄ ,	20	2LiF·BeF ₂ .
J.	"	Y-Z 378-374	80	"	20	"
					trace BeF ₂ .	
K.	H-LB25T10-3	B-D 473-466	Mostly	7LiF·6ThF ₄ ; some QG probably containing 3LiF·ThF ₄ .		
L.	"	F-H 454-449	Mostly	3LiF·ThF ₄ s.s., trace 2LiF·BeF ₂ .		
M.	"	P-R 412-404	90	3LiF·ThF ₄ s.s.,	10	2LiF·BeF ₂
N.	H-LB23T15-1	P-R 479-470	80	LiF·2ThF ₄ ,	20	7LiF·6ThF ₄ , small amount QG.
O.	H-LB23T15-1	U-V 457-453	70	7LiF·6ThF ₄ ,	30	LiF·2ThF ₄
P.	"	W-Y 448-439	60	LiF·2ThF ₄ ,	40	3LiF·ThF ₄ s.s.
Q.	"	Z 435	30	"	60	"
					10	2LiF·BeF ₂ .
R.	H-LB21T25-1	X-Z 594-580	> 95	LiF·2ThF ₄ , trace unid.		

Each of these samples had been previously examined petrographically by H. Insley.

1891 Production batch samples (J. Truitt)

- A. Mg18 MgF_2 . >95 MgF_2 , <5 MgO
- B. Y-19. YF_3 Good YF_3 .
- C. Y-20 YF_3 ~95 YF_3 , ~5 unid.
- D. Y-21 YF_3 (from front part of reactor chamber) Same as C.
- E. Y-21 YF_3 (from rear part of reactor chamber) Same as C.
- F. Y-21 YF_3 Same as C.

1892 LiF- BeF_2 - ThF_4 quenches.

- A. H-LB65T10-1 Q-640 ThF_4 and glass.
- B. " R-632 ThF_4 , $\text{LiF} \cdot 4\text{ThF}_4$, and glass.
- C. " S-624 $\text{LiF} \cdot 4\text{ThF}_4$ and glass.
- D. " N-P 662-647 Mostly glass, small amount ThF_4 .
- E. " W-Y 594-580 $\text{LiF} \cdot 4\text{ThF}_4$ and glass.
- F. H-LB45T35-1 T-V 685-669 ThF_4 and glass.
- G. H-LB63T20-1 V-X 601-586 ThF_4 , glass and trace $\text{LiF} \cdot 4\text{ThF}_4$
- H. H-LB45T35-1 W-Z 660-638 $\text{LiF} \cdot 4\text{ThF}_4$ and QG.
- I. H-LB65T10-1 H-J 709-695 All glass.
- J. " K-M 686-670 All glass.
- K. H-LB63T20-1 Y-Z 580-574 Mostly $\text{LiF} \cdot 4\text{ThF}_4$, contains some QG.
- L. H-LB45T15-1 U-W 608-594 $\text{LiF} \cdot 4\text{ThF}_4$ and QG, no ThF_4 .
- M. H-LB41T15-1 Y-Z 594-580 All $\text{LiF} \cdot 4\text{ThF}_4$.

Each of these samples had been previously examined petrographically by C. F. Weaver.

1893 LiF- ThF_4 - UF_4 quenches.

- A. H-LU36.2T10-3 P-R 565-554 All $7\text{LiF} \cdot 6\text{U}(\text{Th})\text{F}_4$.
- B. H-LU31.2T15-2 J-L 598-587 All $7\text{LiF} \cdot 6\text{UF}_4$, cell size enlargement not appreciable.
- C. H-LU20T60-2 X-Z 864-852 50 ThF_4 , 50 $\text{LiF} \cdot 4\text{ThF}_4$, trace unid., no UO_2 .
- D. " α 846 45 ThF_4 , 45 $\text{LiF} \cdot 4\text{ThF}_4$, 10 unid., as in C.
- E. Scale from exterior of LiF- BeF_2 - ThF_4 quench tube. (Friedman) 40 $\text{LiF} \cdot 4\text{ThF}_4$, 60 $\text{LiF} \cdot 2\text{ThF}_4$, no ThO_2 .

1894

- A. C-35 E.E.1242. 70 $\text{NaF} \cdot \text{BeF}_2$, 30 β $2\text{NaF} \cdot \text{BeF}_2$. β $2\text{NaF} \cdot \text{BeF}_2$ may be stabilized in this melt by the presence of small amounts of dissolved oxide.
- B. C-35 E.E.1244 80 $\text{NaF} \cdot \text{BeF}_2$, 20 β $2\text{NaF} \cdot \text{BeF}_2$.
- C. C-84 No. 3473 40 $2\text{LiF} \cdot \text{BeF}_2$, 60 $2\text{NaF} \cdot \text{LiF} \cdot 2\text{BeF}_2$
- D. C-122 No. 3520 All $7\text{NaF} \cdot 6\text{Zr}(\text{U})\text{F}_4$
- E. C-122 No. 3541 " "
- F. C-123 E.E.1239 30 $7\text{NaF} \cdot 6\text{UF}_4$, 30 $\text{NaF} \cdot \text{BeF}_2$.
- G. C-124 No. 3471 50 $\text{NaF} \cdot \text{BeF}_2$, 50 unidentified. (This unidentified phase has been observed previously.)
- H. C-126 E.E.1240 75 $2\text{LiF} \cdot \text{BeF}_2$, 5 $\text{LiF} \cdot 4\text{UF}_4$, 20 unidentified, no UO_2 .
- I. C-126 E.E.1246 70 $2\text{LiF} \cdot \text{BeF}_2$, 20 $\text{LiF} \cdot 4\text{UF}_4$, 10 BeF_2 .

- J. C-128 No. 3544 80 3LiF.ThF₄, 20 LiF.2ThF₄.
 K. C-128 No. 3581 80 " 20 "
 L. C-128 No. 3595 30 LiF.2ThF₄, 70 3LiF.ThF₄.
 M. C-129 No. 3596 60 7NaF.6Zr(U)F₄, 40 3NaF.4ZrF₄. Estimate that this sample is at least 5 mole % higher in ZrF₄ than is indicated by composition of C-129.
 N. C-130 E.E.1237 90 2LiF.BeF₂, 10 LiF.4UF₄
 O. C-130 No. 3469 95 2LiF.BeF₂, 10 LiF.4UF₄
 P. C-130 No. 3475 90 2LiF.BeF₂, 10 UO₂
 Q. C-130 E.E.130 ECS-1 80 2LiF.BeF₂, 20 LiF.4UF₄.
 R. C-130 E.E.1243 80 2LiF.BeF₂, 20 LiF.4UF₄.
 S. C-131 E.E.1234 60 2LiF.BeF₂, 70 7LiF.6UF₄, 15 LiF.4UF₄, 5 BeF₂.
 T. C-131 E.E.1235 60-70 LiF.4UF₄, 30-40 2LiF.BeF₂.
 U. C-132 E.E.1241 >95 2LiF.BeF₂, <5BeF₂
 V. C-31 E.E.999 Mostly unidentified material, Small amounts of 7NaF.6ZrF₄ and ZrF₄. C. Weaver and T. N. McVay get same results. Sample submitted was labeled NaF-LiF-ZrF₄. X-ray and petrog. suggest this is not C-31.
 W. E.E. 1238 23 NaF-30 LiF-47 BeF₂. Contains no crystalline material. If small amounts of impurities are critical in the use of this material, TA and quenching experiments should first be made with it.
 X. 64 LiF-36 BeF₂ No. 3474 >95 2LiF.BeF₂, <5 BeF₂.
 Y. C-132 E.E. 1236 70 2LiF.BeF₂, 30 BeF₂.
 Z. C-123 E.E. 1303 No. 3472 80 NaF.BeF₂, 20 7NaF.6UF₄.

1895 NaF-ThF₄ Quenches

- A. H-NT41-1 F-G 727-715 703NaF.2ThF₄, 30 NaF.ThF₄
 B. " H 709 50 " , 50 unidentified
 C. Weaver also shows this unidentified phase is unique in this temperature sequence. There is no evidence that this is an equilibrium phase.
 C. " K 688 90 3NaF.2ThF₄, 10 NaF.ThF₄
 D. " L 680 50 " , 25 " , 25 2NaF.ThF₄
 E. " M 674 times " , 50 " , 50 "
 Samples L and M show that the formation-decomposition temperature for 3NaF.2ThF₄ is 677 ± 3°C.
 F. " N 666 50 2NaF.ThF₄, 50 NaF.ThF₄
 G. " BB 568 50 " , 50 "
 H. H-NT43-1 J-L 713-704 90 3NaF.ThF₄, 10 NaF.ThF₄
 I. H-NT44.5-1 D-E 711-704 30 3NaF.ThF₄, 70 NaF.ThF₄
 J. H-NT46.2-1 H 705 40 " 60 " ; trace NaF.2ThF₄
 K. " I 645 50 3NaF.ThF₄, 50 NaF.ThF₄
 L. " L 664 50 " , 50 "
 M. H-NT50-2 W-X 696-690 90 NaF.ThF₄, 10 NaF.2ThF₄
 N. H-NT60-1 R-T 679-655 70 NaF.2ThF₄, 30 NaF.ThF₄.

1896 $7\text{LiF} \cdot 6\text{ThF}_4$ formation-decomposition temperature study.

- A. F-310 R 53.8 $\text{LiF} \cdot 46.2\text{ThF}_4$ slowly cooled melt. This is the starting material for H-LT46.2-3
- B. H-LT46.2-3 Y-Z 417-414 This series was brought to and held at temperature for a week's duration.
 $90\ 7\text{LiF} \cdot 6\text{ThF}_4$, $10\ 3\text{LiF} \cdot \text{ThF}_4$
 Two other $\text{LiF} \cdot \text{ThF}_4$ quenching experiments were made concurrently with this one, H-LT33.3-2 and H-LT30-1. Since they showed the same phases at the lowest temperatures as H-LT 46.2-3, no X-ray data were taken. The results of these three experiments show that the lower temperature of stability for $7\text{LiF} \cdot 6\text{ThF}_4$ is below 414°C .

1897 Service samples

- A. RS 5010 $63\text{LiF} \cdot 37\text{BeF}_2$ containing 3 wt % FeF_2 . (R. Sheil)
 All $2\text{LiF} \cdot \text{BeF}_2$. No evidence of a FeF_2 containing phase in the X-ray pattern.
- B. N-50 C-45 CrF_2 No. 1 Sample No. 8. Contains ~1 wt % CrF_2 (C. M. Blood) Mostly $7\text{NaF} \cdot 6\text{ZrF}_4$. Contains small but identifiable amounts of $\text{NaF} \cdot \text{ZrF}_4$ and $\text{NaF} \cdot \text{CrF}_2 \cdot 2\text{ZrF}_4$
- C. N-50 C-45 CrF_2 No. 1 Sample No. 88. Contains ~4 wt % CrF_2 . (C. M. Blood) $45\ \beta_2\ 2\text{NaF} \cdot \text{ZrF}_4$, $45\ \text{NaF} \cdot \text{CrF}_2 \cdot 2\text{ZrF}_4$, $10\ 3\text{NaF} \cdot 2\text{ZrF}_4 - 7\text{NaF} \cdot 6\text{ZrF}_4$ s.s.
- D. E-2 XX-96 Scale on cobalt specimen immersed in C-30. (pink). J. E. Bigelow. $50\ 3\text{NaF} \cdot 6\text{ZrF}_4$, $45\ \text{NaF} \cdot \text{CoF}_2 \cdot 2\text{ZrF}_4$, 5 unidentified, possibly $\text{CoF}_2 \cdot 4\text{H}_2\text{O}$. The formula $\text{NaF} \cdot \text{CoF}_2 \cdot 2\text{ZrF}_4$ is an inference. The structural metal fluorides FeF_2 , CrF_2 , NiF_2 form a solid phase of this stoichiometry (cf. T-1715.) and this CoF_2 phase is apparently isostructural with those formed by FeF_2 , CrF_2 , and NiF_2 .

1898 $\text{NaF} \cdot \text{ThF}_4$ Quenches

A.	H-NT 50-3	D 579	90	$\text{NaF} \cdot \text{ThF}_4$	10	$\text{NaF} \cdot 2\text{ThF}_4$
B.	"	E 574	90	"	10	"
C.	"	F 569	90	"	10	"
D.	"	G 564	70	"	10	" , 20 unid.
E.	"	H-I	559-554	30 $\text{NaF} \cdot \text{ThF}_4$	70	unidentified.
F.	"	J-K	549-544	20	"	80 unidentified.
G.	"	L 538	20	$\text{NaF} \cdot \text{ThF}_4$	80	unid.
H.	"	Q-R	"	"	"	"
I.	"	V-X	481-468	5-10 $\text{NaF} \cdot \text{ThF}_4$	90-95	unid.

- J. H-NT 52-1 U 588 85 NaF.ThF₄, 15 NaF.2ThF₄
 K. H-NT 66.7-2 S 611 All NaF.2ThF₄

If it were certain that the samples in this quench series were within 50 ± 1 mole % ThF₄, these results, along with the results from T-1895, would indicate that the phase labeled NaF.ThF₄ should appear as a single phase at ~48 mole % ThF₄, and that the unidentified phase found in samples G-X is a subsolidus compound occurring at 50 mole % ThF₄ or slightly higher. This phase apparently has an upper temperature of stability of $564 \pm 5^\circ\text{C}$.

- 1899 Purified BeF₂ for LiF-BeF₂-ThF₄ quenching studies. H. A. Friedman. This sample contained many white opaque inclusions after it was melted with NH₄F.HF, X-ray pattern shows only low quartz form of BeF₂.
- 1900 H-RU18-2 X-Z 421-413 The sample tube containing this quench series ruptured while it was in the furnace. The predominant phase in samples X-Z closely resembles the yellow unidentified phase observed in H-RU25-6 A-482 (cf. T-1889). Small amounts of 3RbF.UF₄ is also present.