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PHASE EQUILIBRIUM DIAGRAMS FOR FUSED SALT SYSTEMS

R. E. Thoma
W. R. Grimes

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R. E. Thoma
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PHASE EQUILIBRIUM DIAGRAMS FOR FUSED SALT SYSTEMS

Research on liquid fused salt fuels should begin with phase equilibrium studies. This report is a summary of the current status of the fused salt systems which have been under study in the ANP Chemistry Section during the last several years.

The inclusion of a phase equilibrium diagram in this report is not an indication that it represents a finished study. It has been necessary to minimize the emphasis on several systems as it became clear that these systems promised small returns to the ANP fuels program.

Discussions regarding the extent of the study and phase characteristics of each of these systems are to be found in the references listed in the Table of Contents.

A large number of people have contributed to an understanding of these phase relationships. A partial list of major contributors to these studies includes C. J. Barton, F. F. Blankenship, L. M. Bratcher, V. S. Coleman, H. A. Friedman, H. Insley, B. S. Landau, T. N. McVay, R. E. Moore, R. F. Newton, B. J. Sturm, J. Truitt, G. D. White, and W. C. Whitley.

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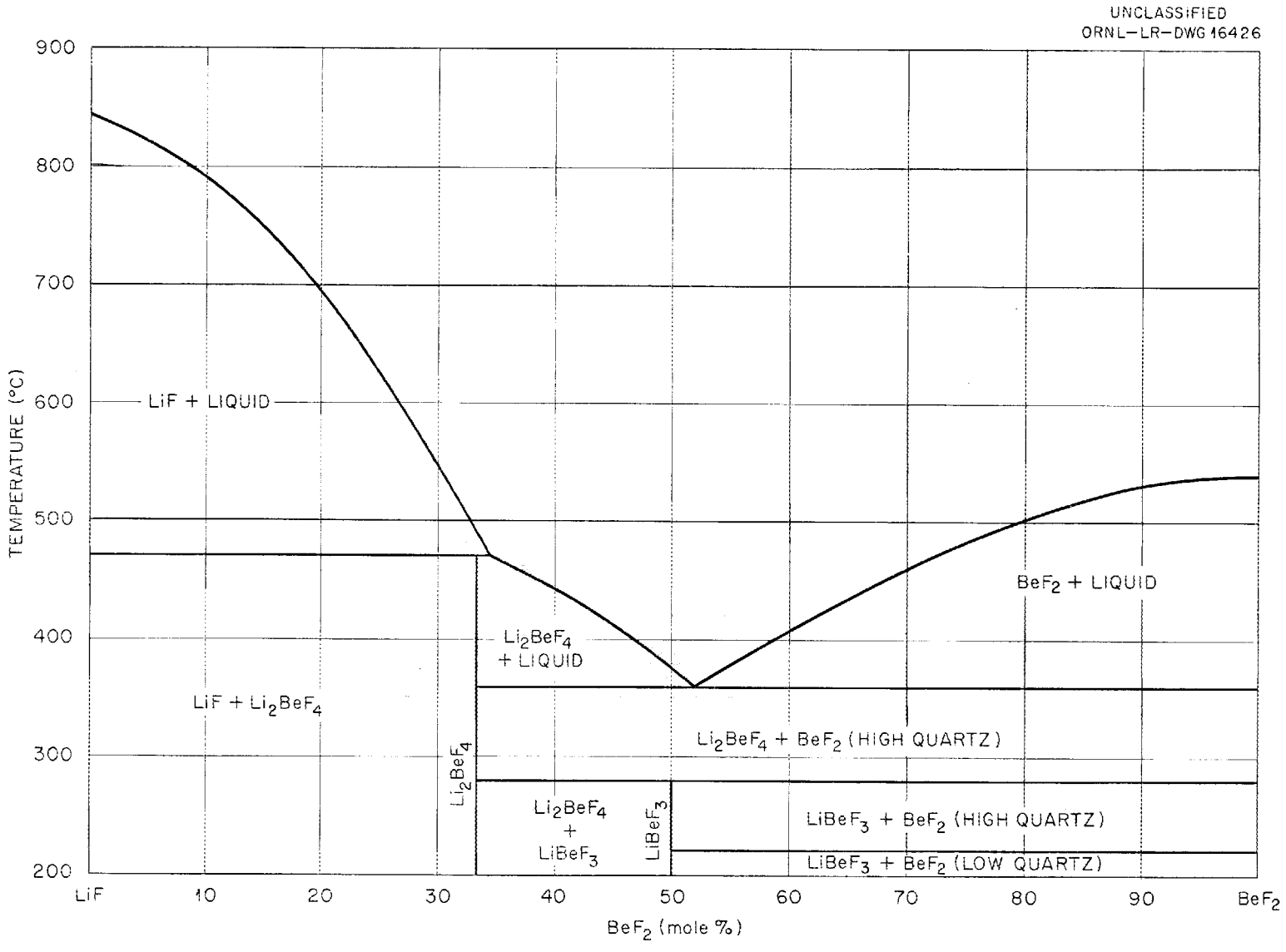
* Final diagram on these systems not determined at ORNL.

** The determination of the incongruent nature of $2LiF.BeF_2$ was made by Mound Laboratory, by ORNL, and also by J. L. Speirs, "The Binary and Ternary Systems Formed by Caf, LiF, and BeF_2: Phase Diagrams and Electrolytic Studies", Ph.D. thesis, Michigan State College, 1952.



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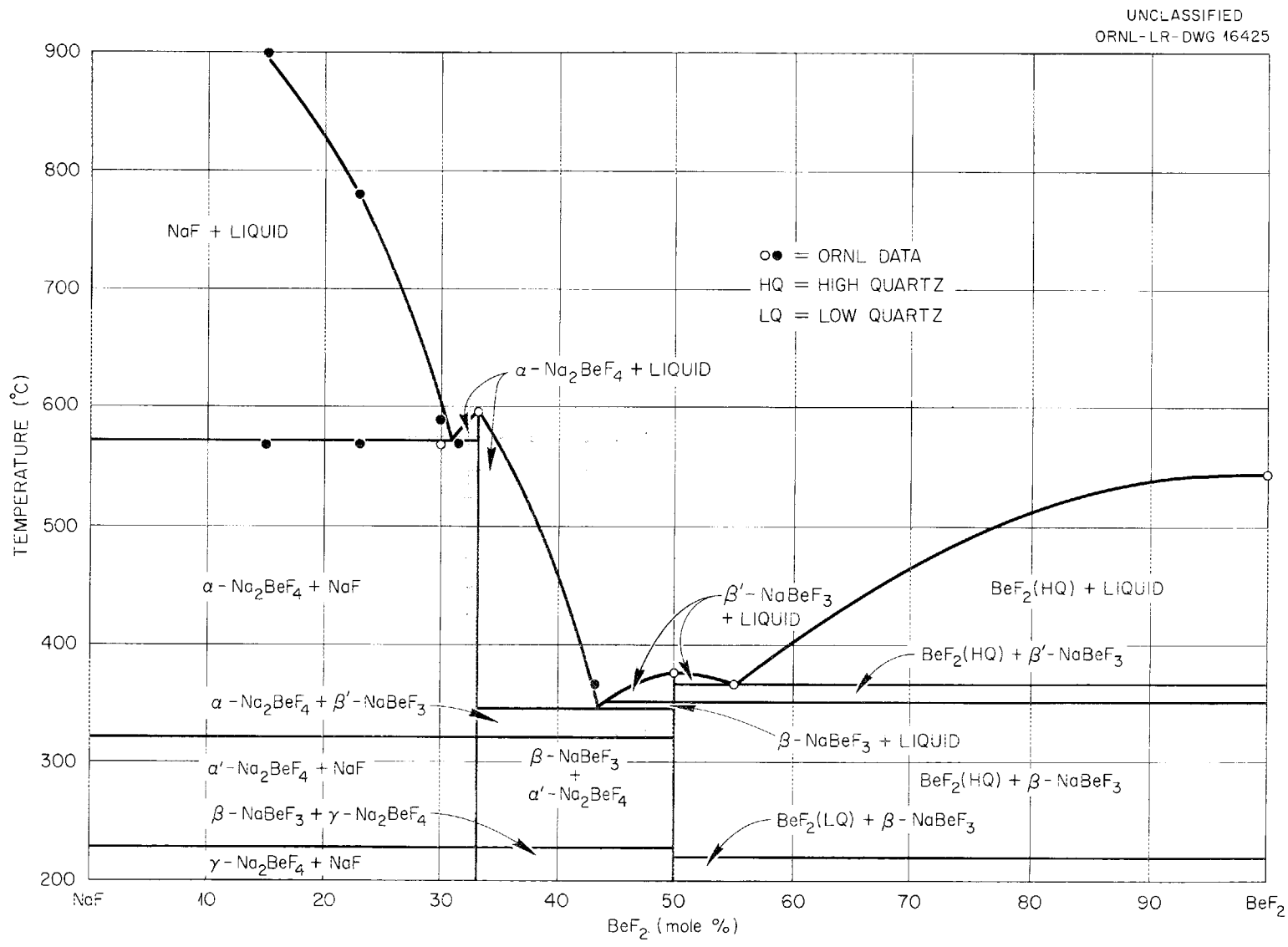

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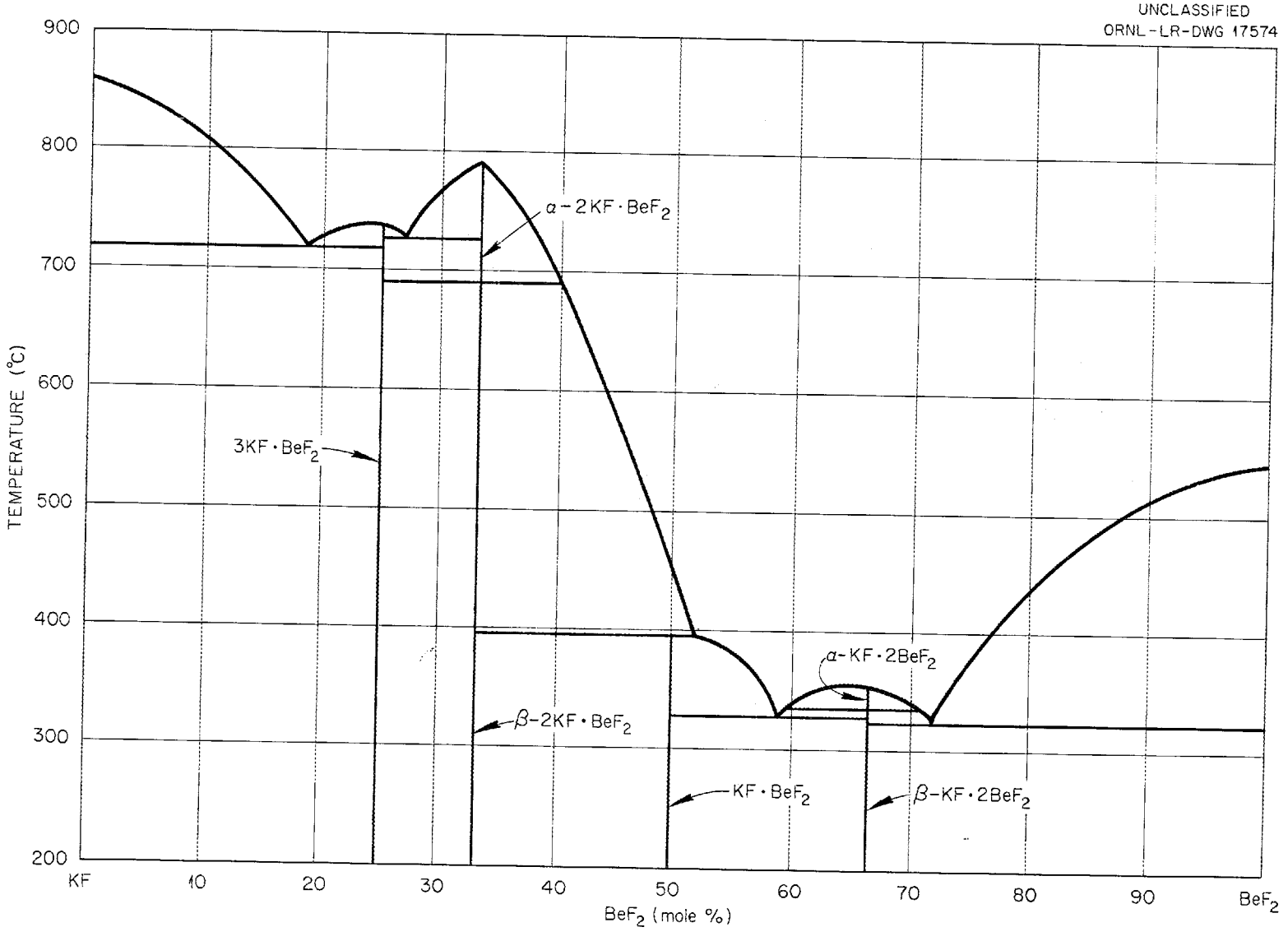

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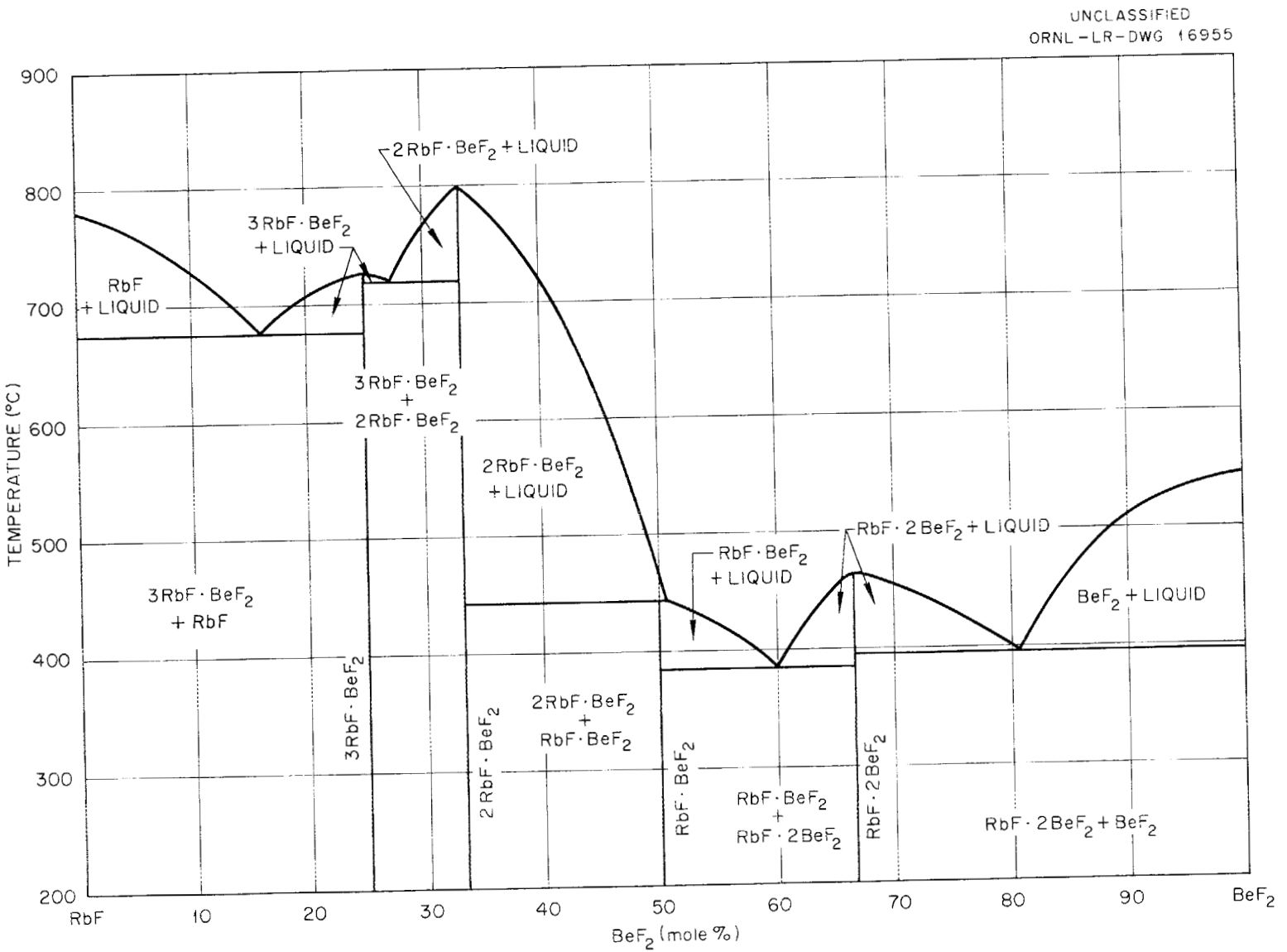

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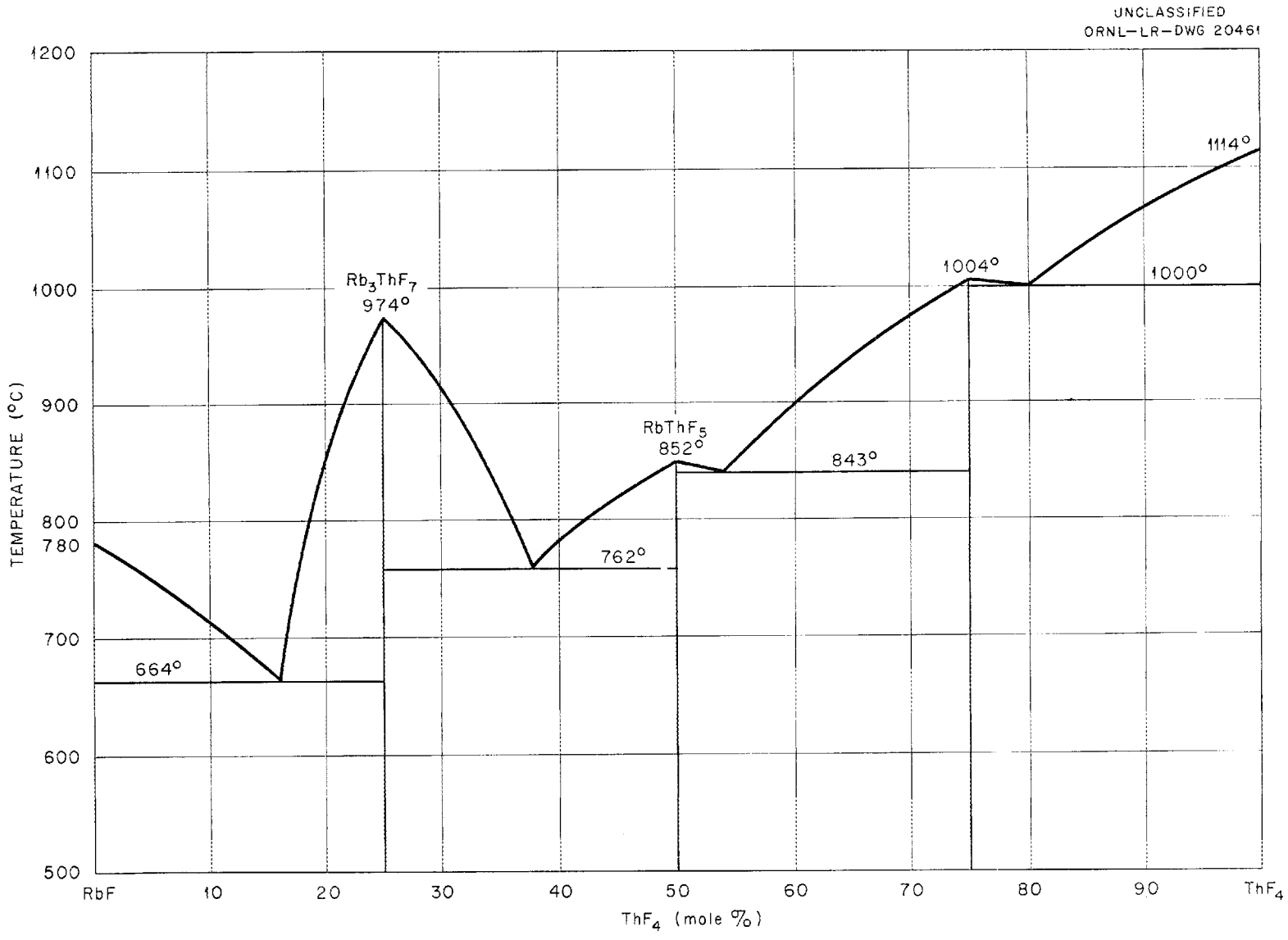

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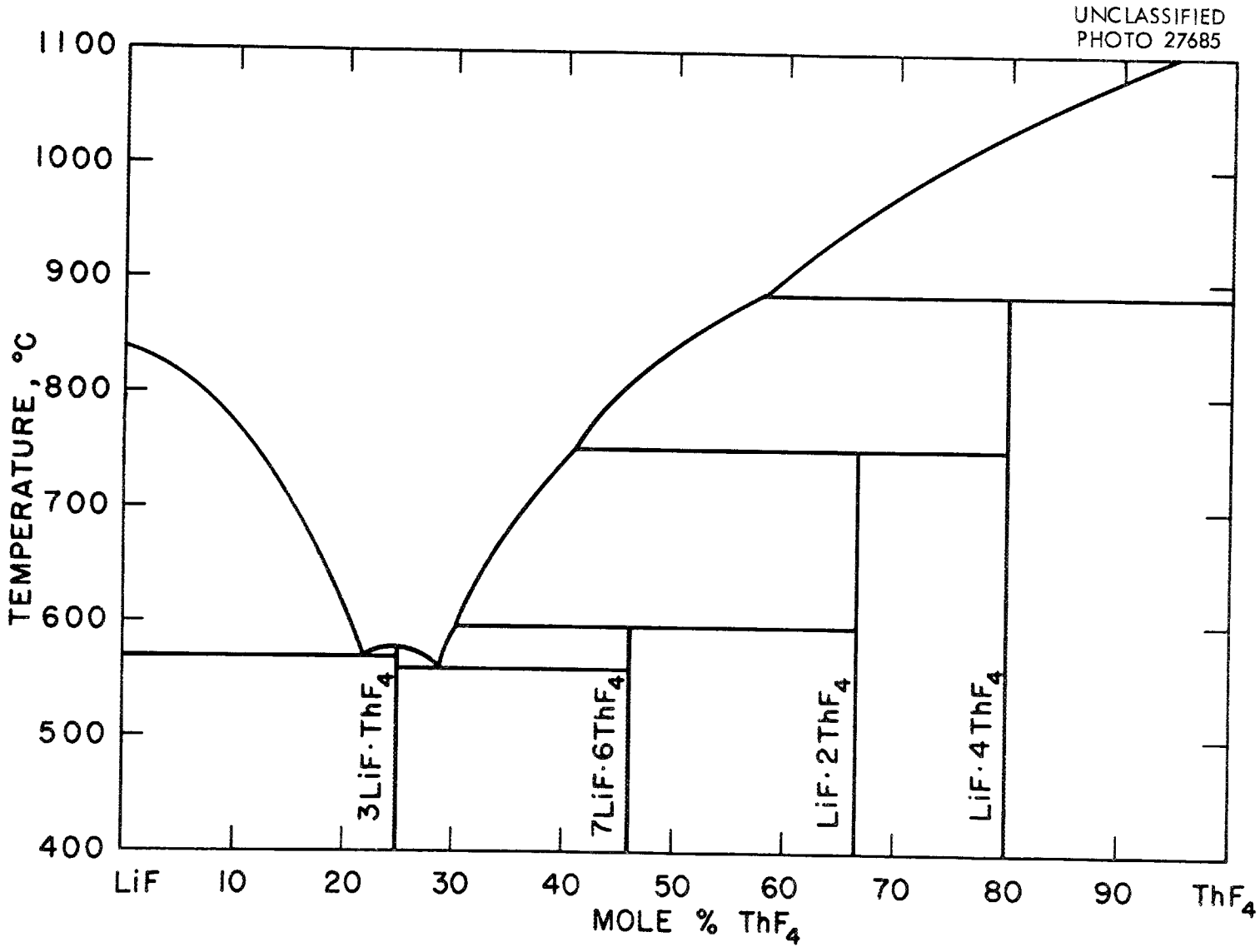

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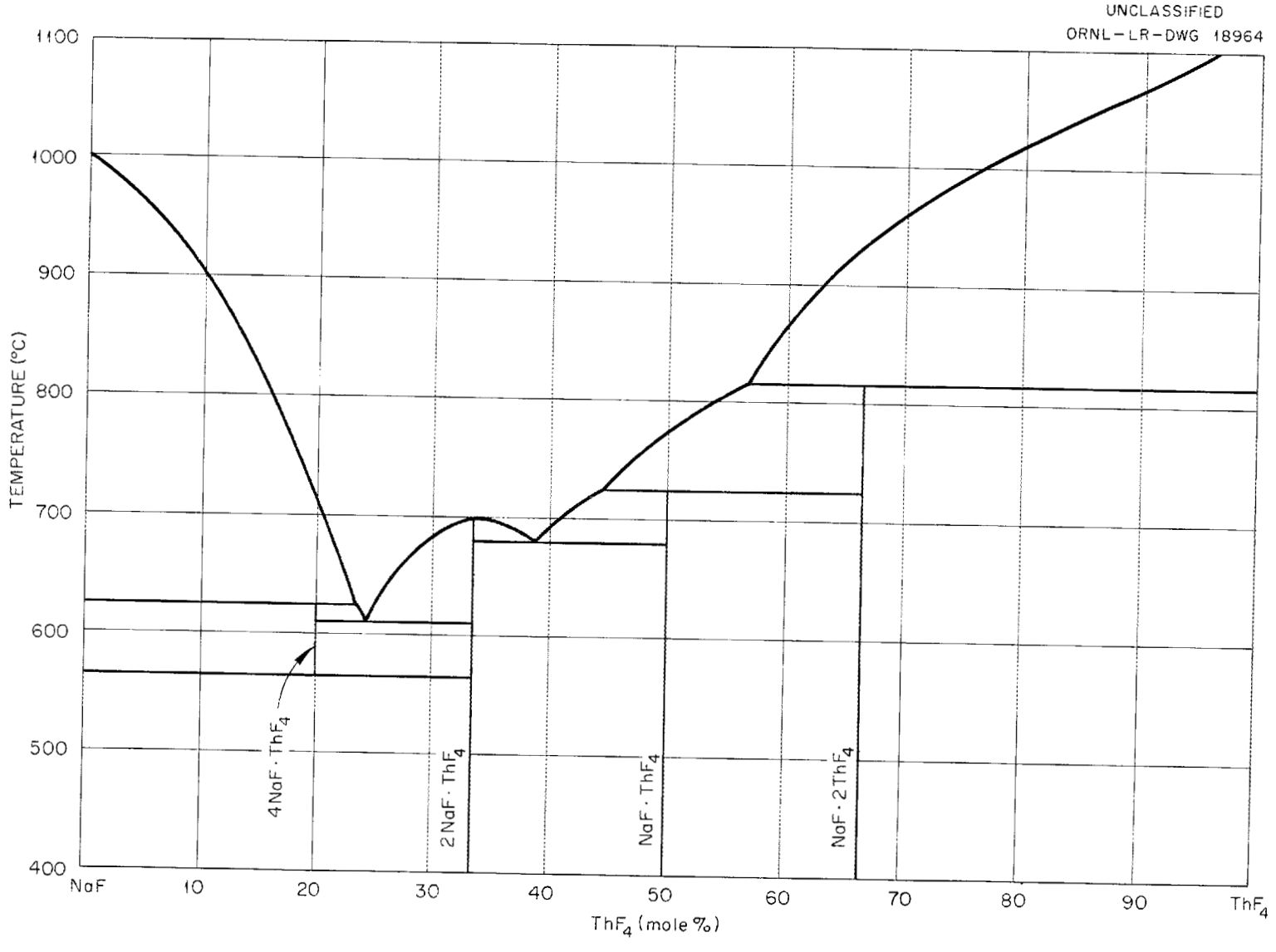

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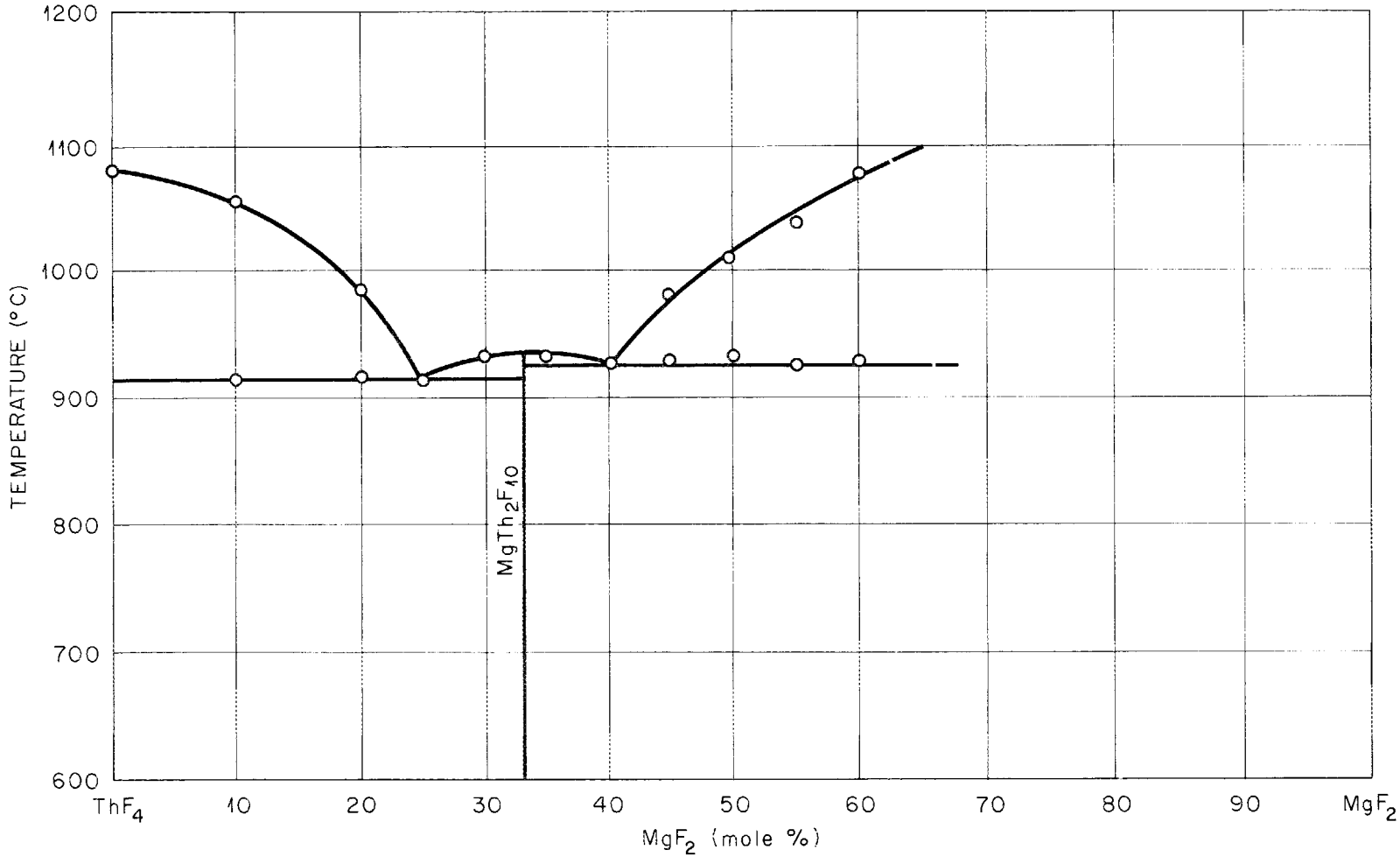

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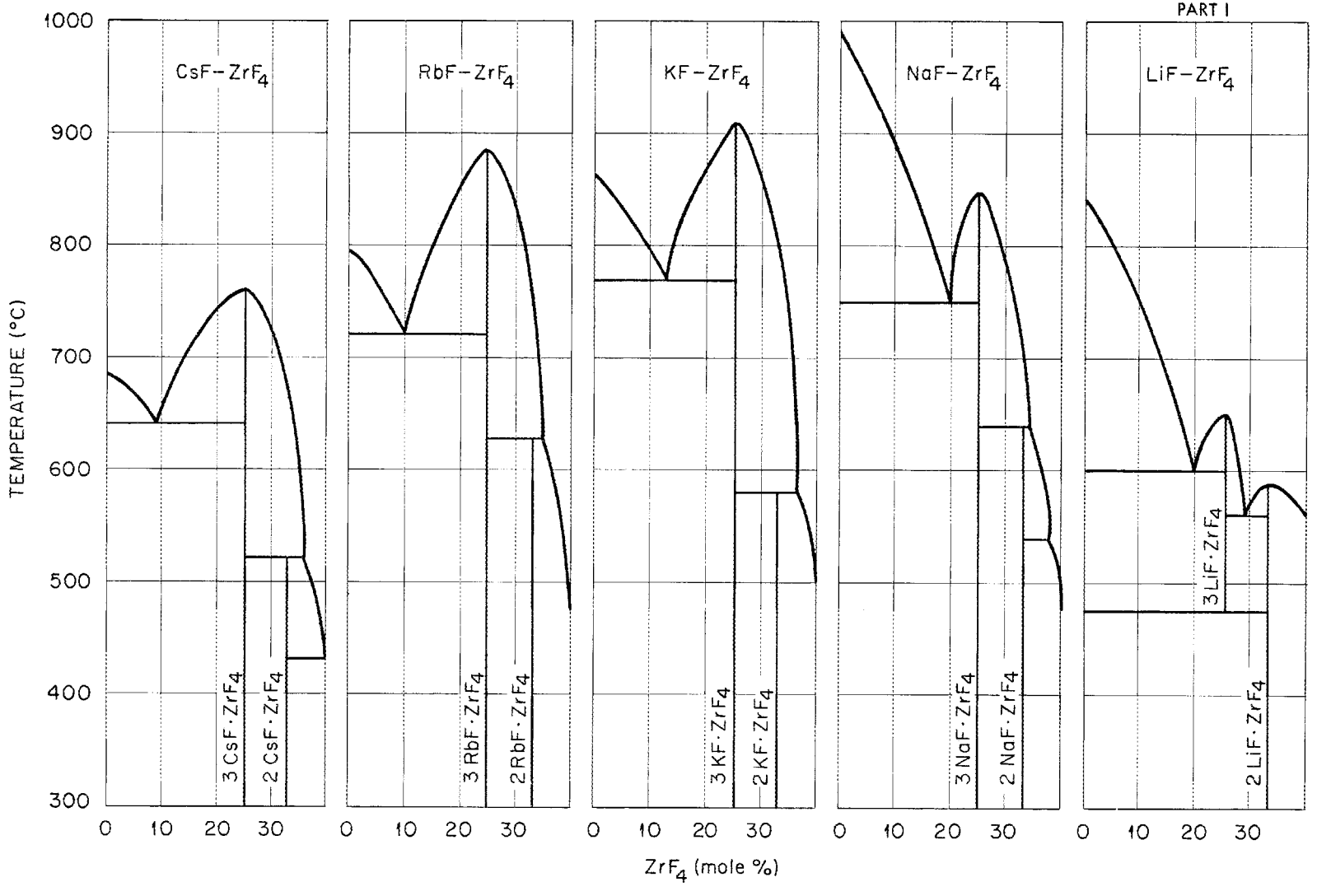

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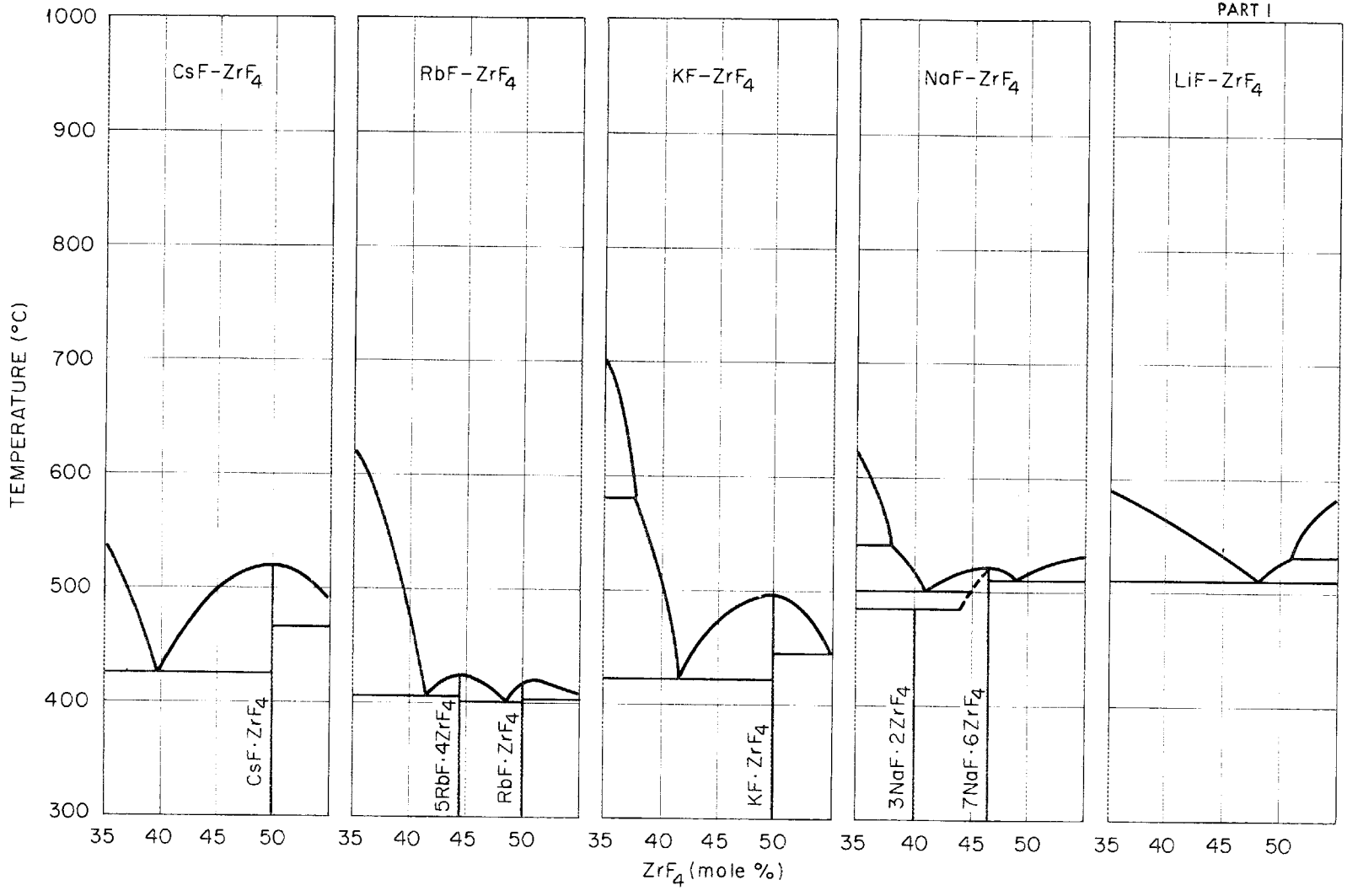

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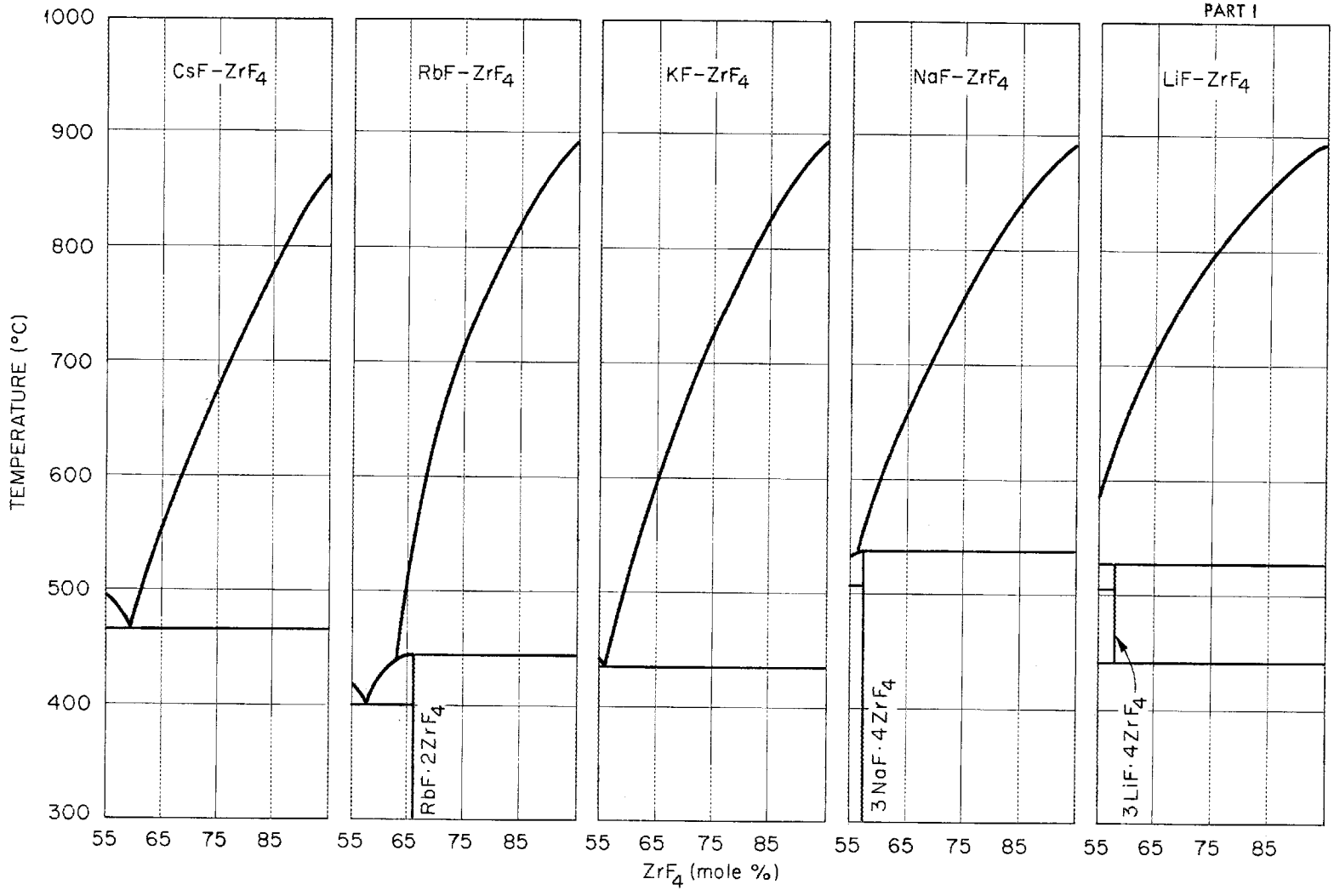

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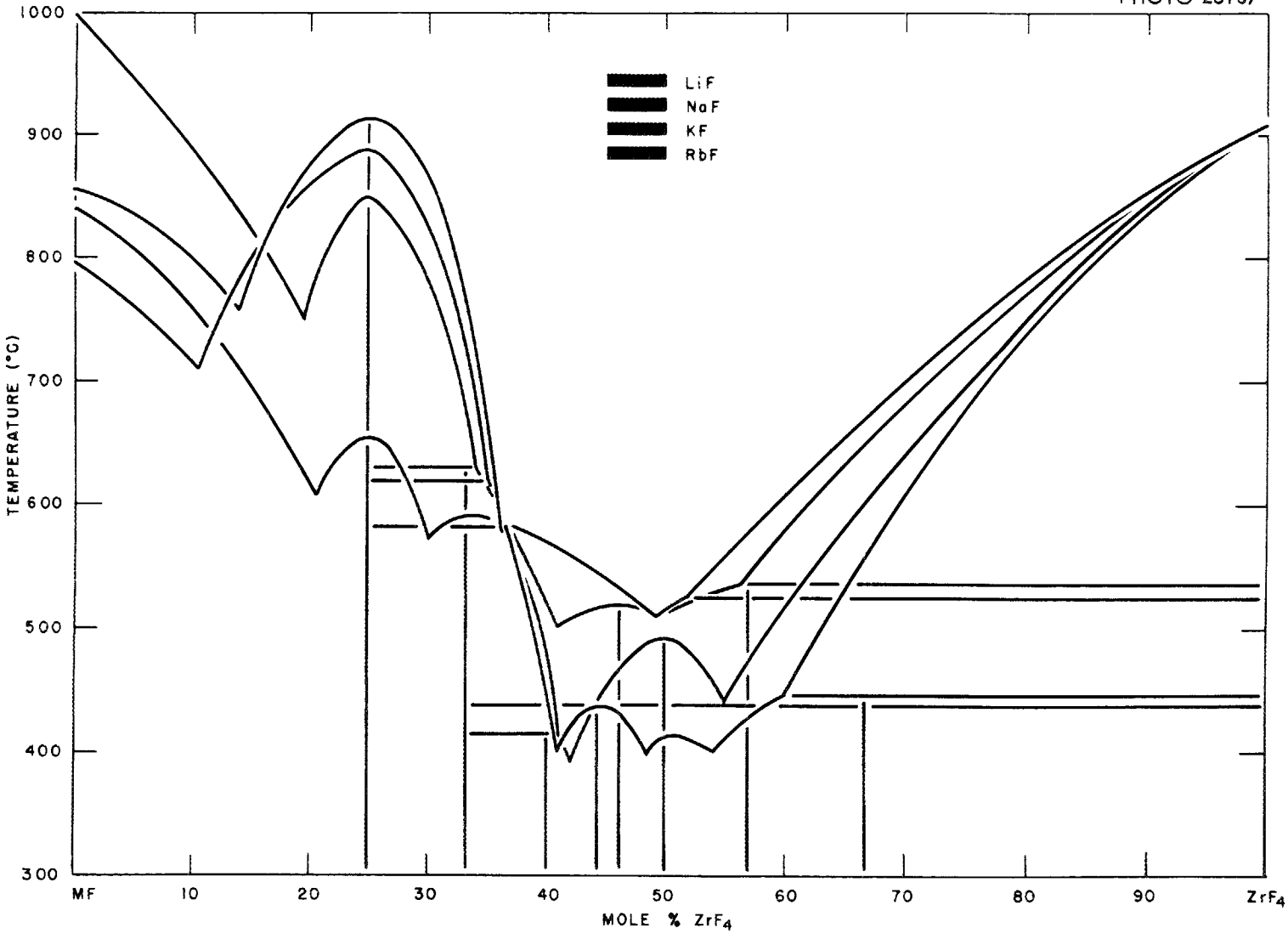

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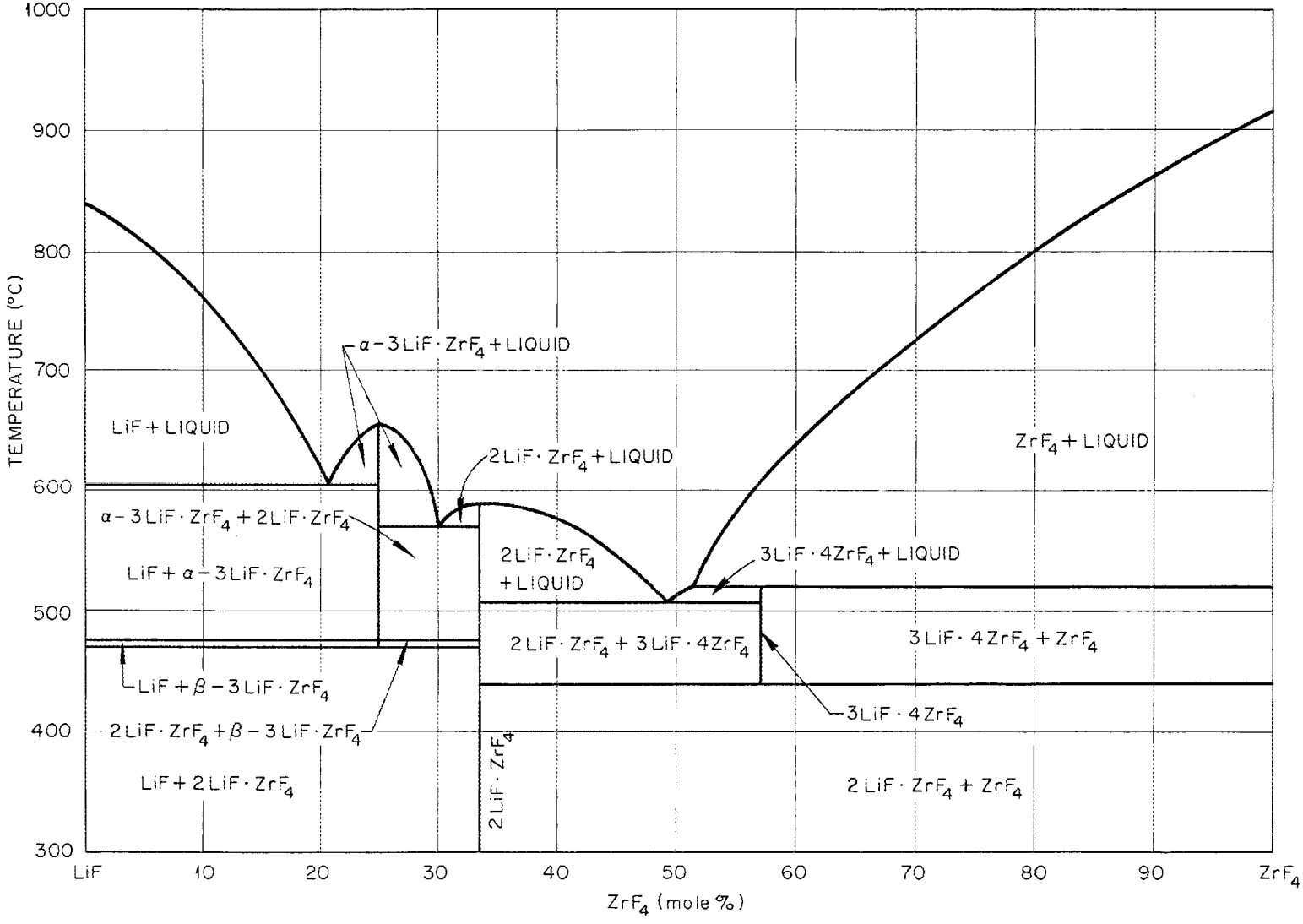
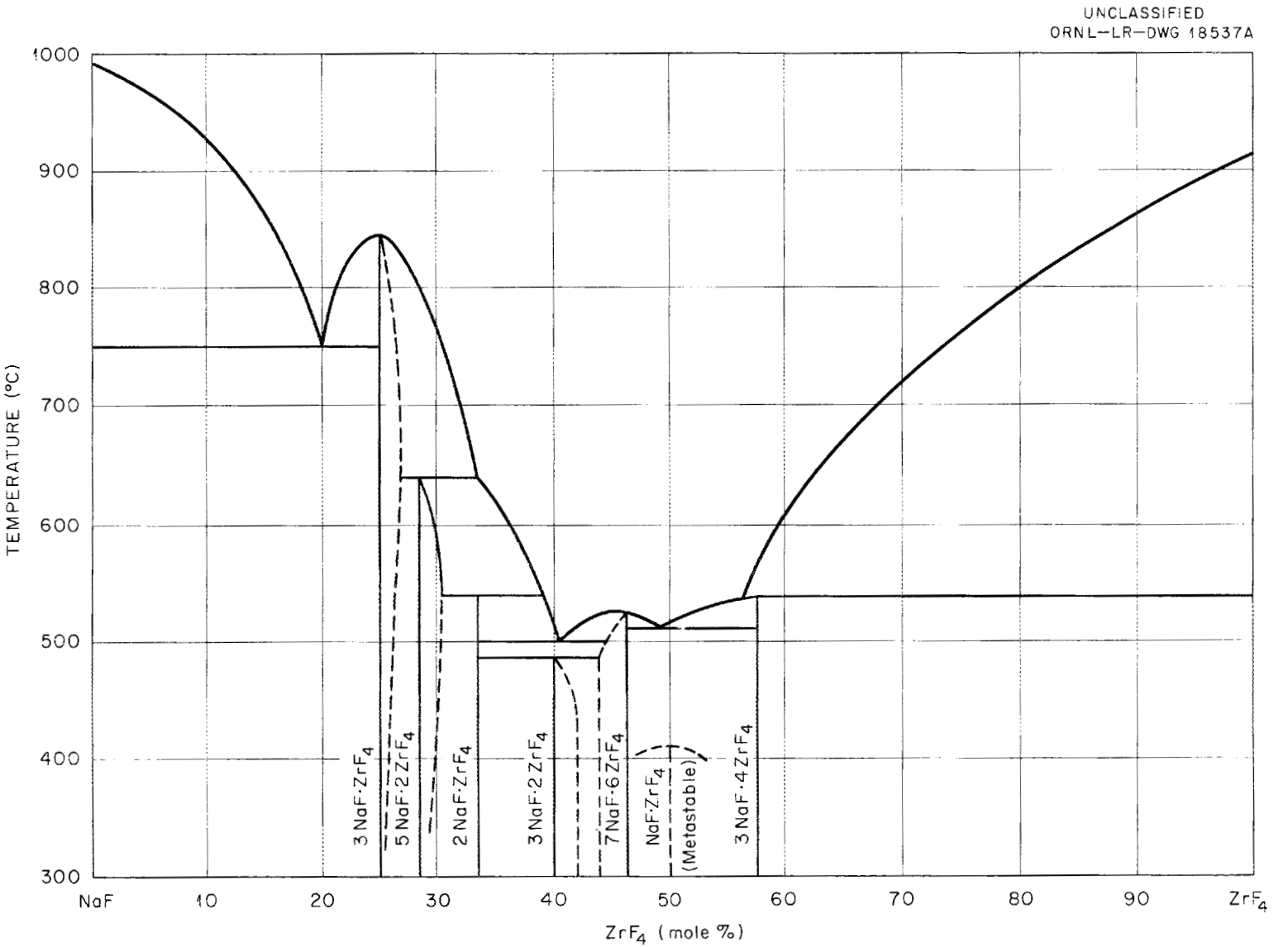


The System $LiF-ZrF_4$.



The System $NaF-ZrF_4$.

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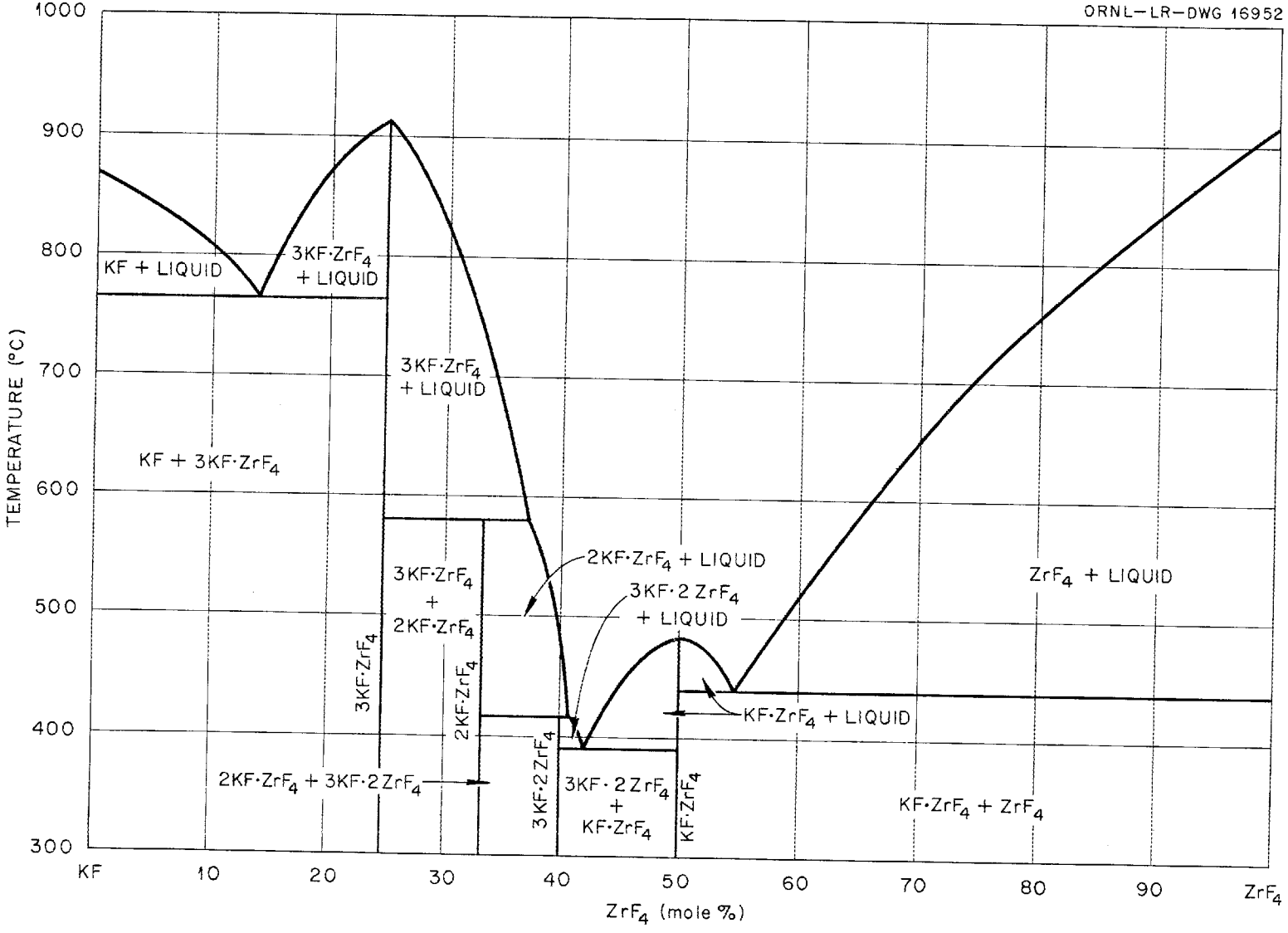

The System KF–ZrF_4.

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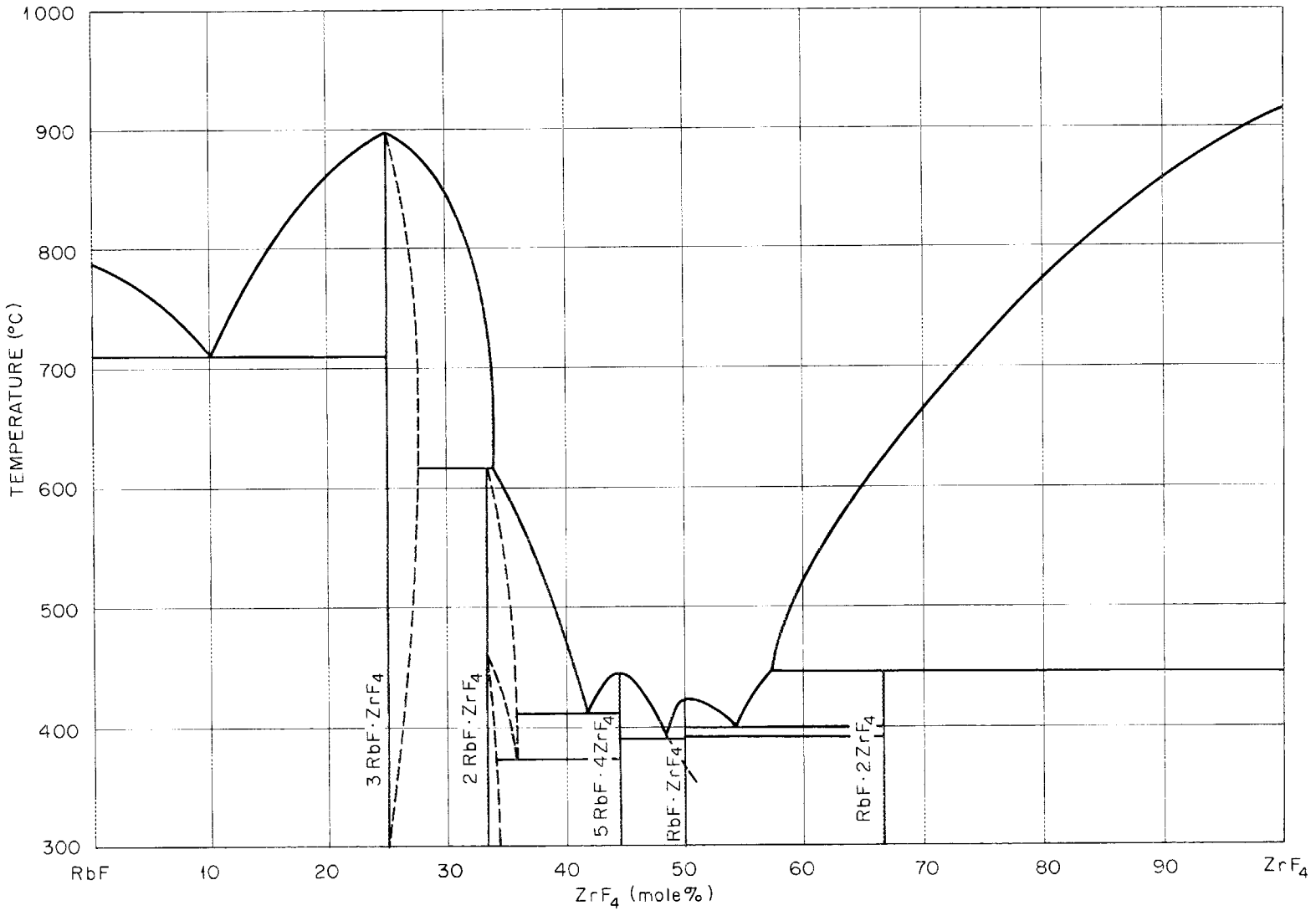
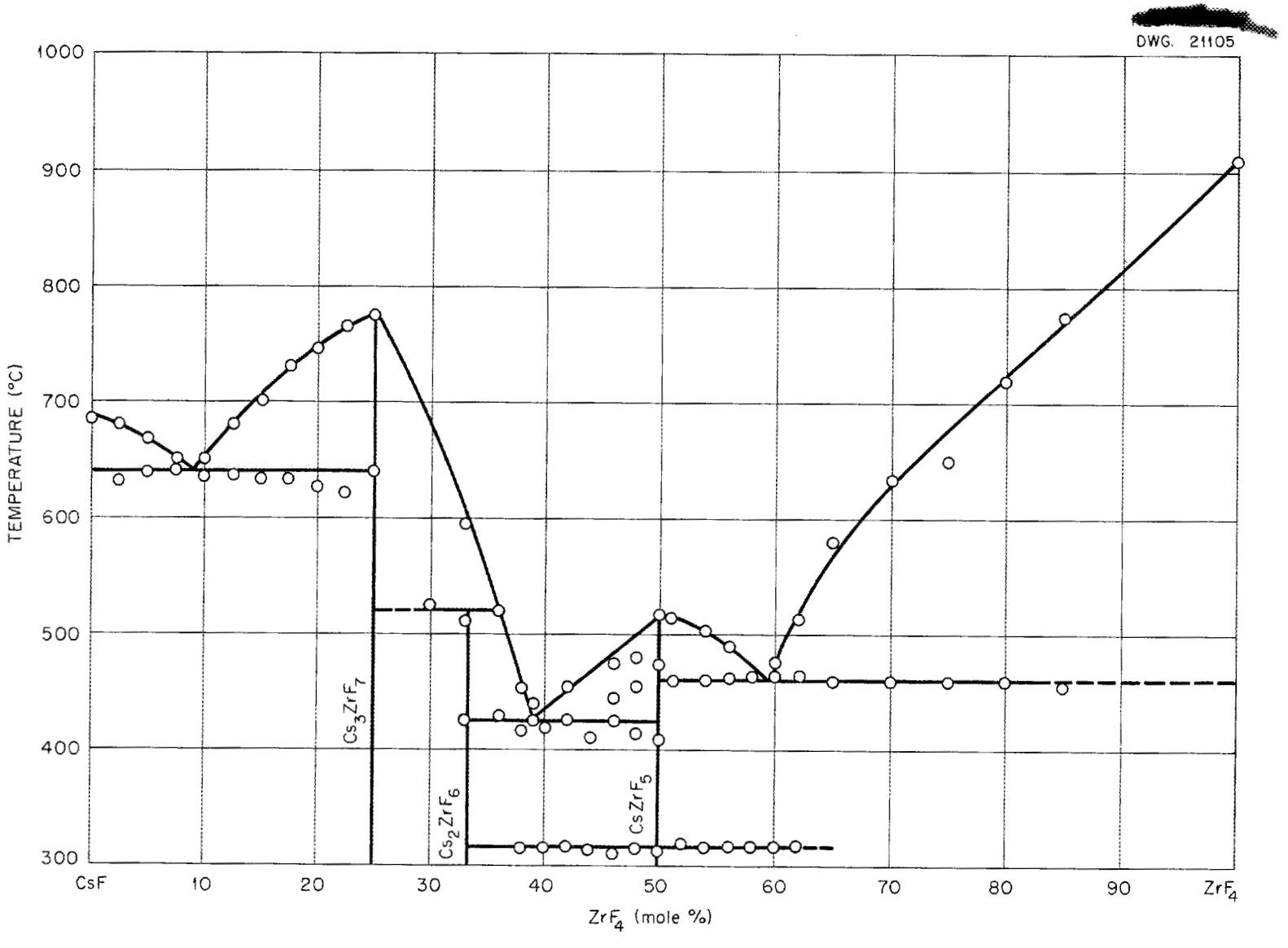
ORNL-LR-DWG 14629

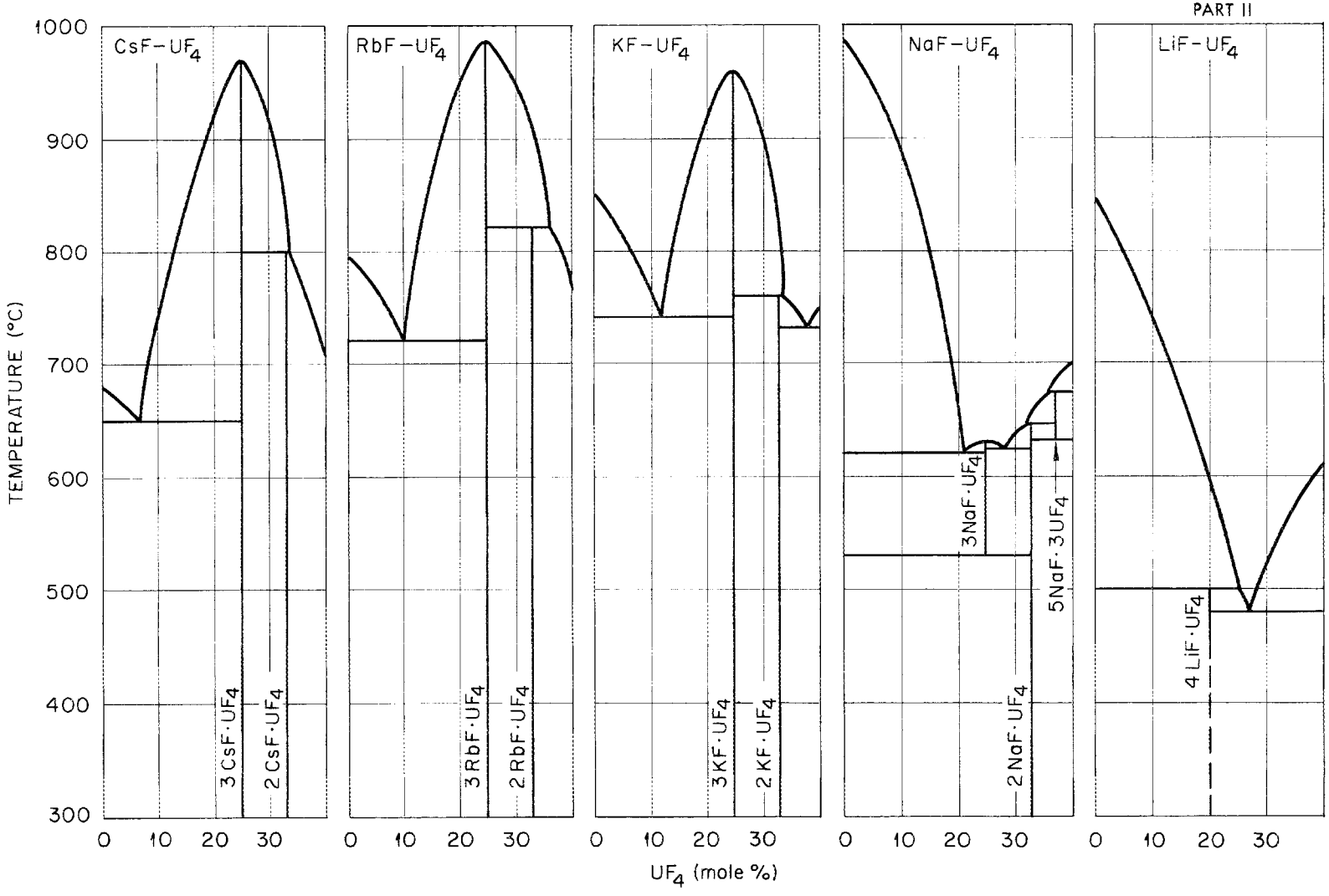


The System RbF–ZrF_4.



The System $CsF-ZrF_4$.

ORNL-LR-DWG. 14626
PART II



The Systems Alkali Fluorides–UF_4.

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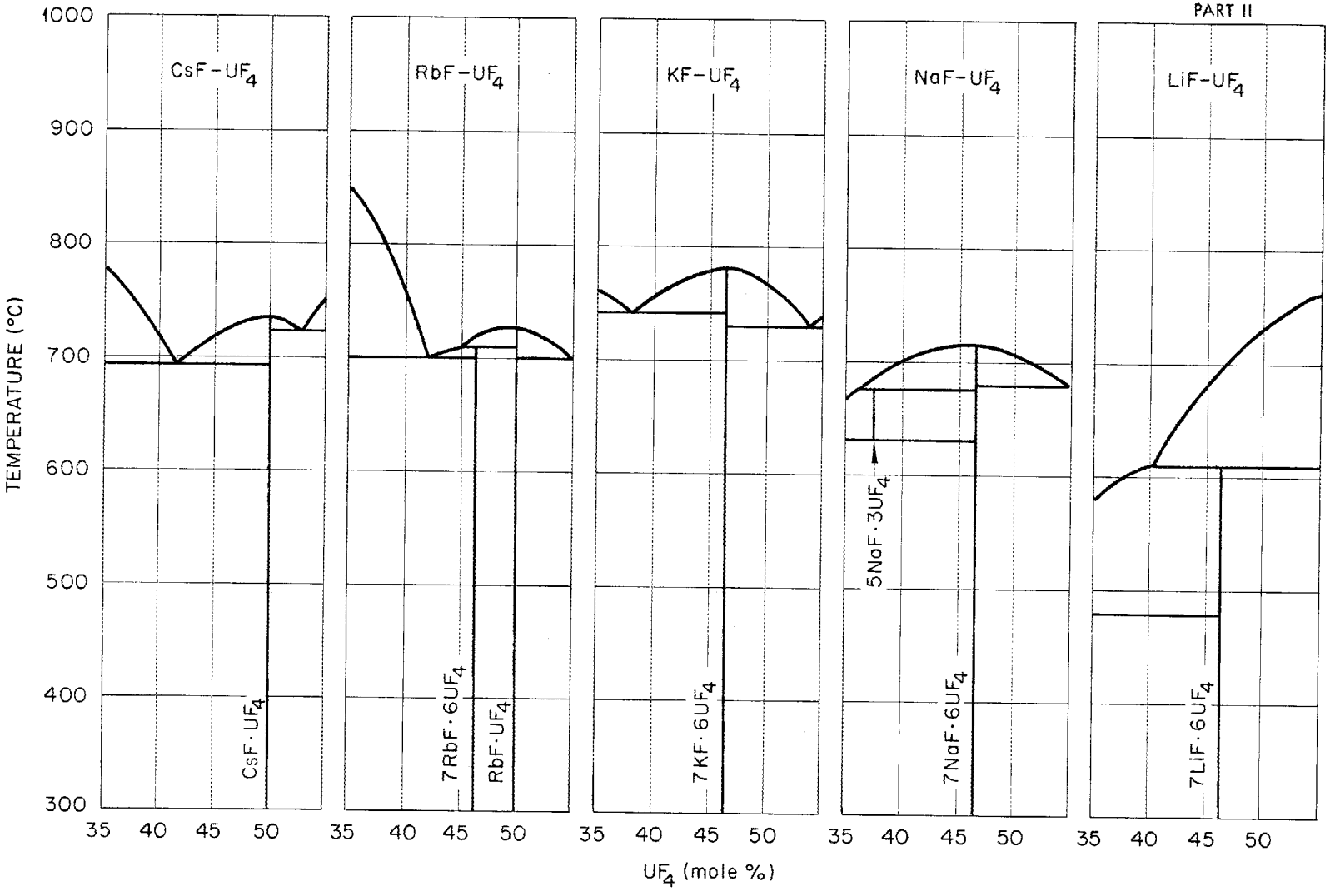
ORNL-LR-DWG. 14627
PART II



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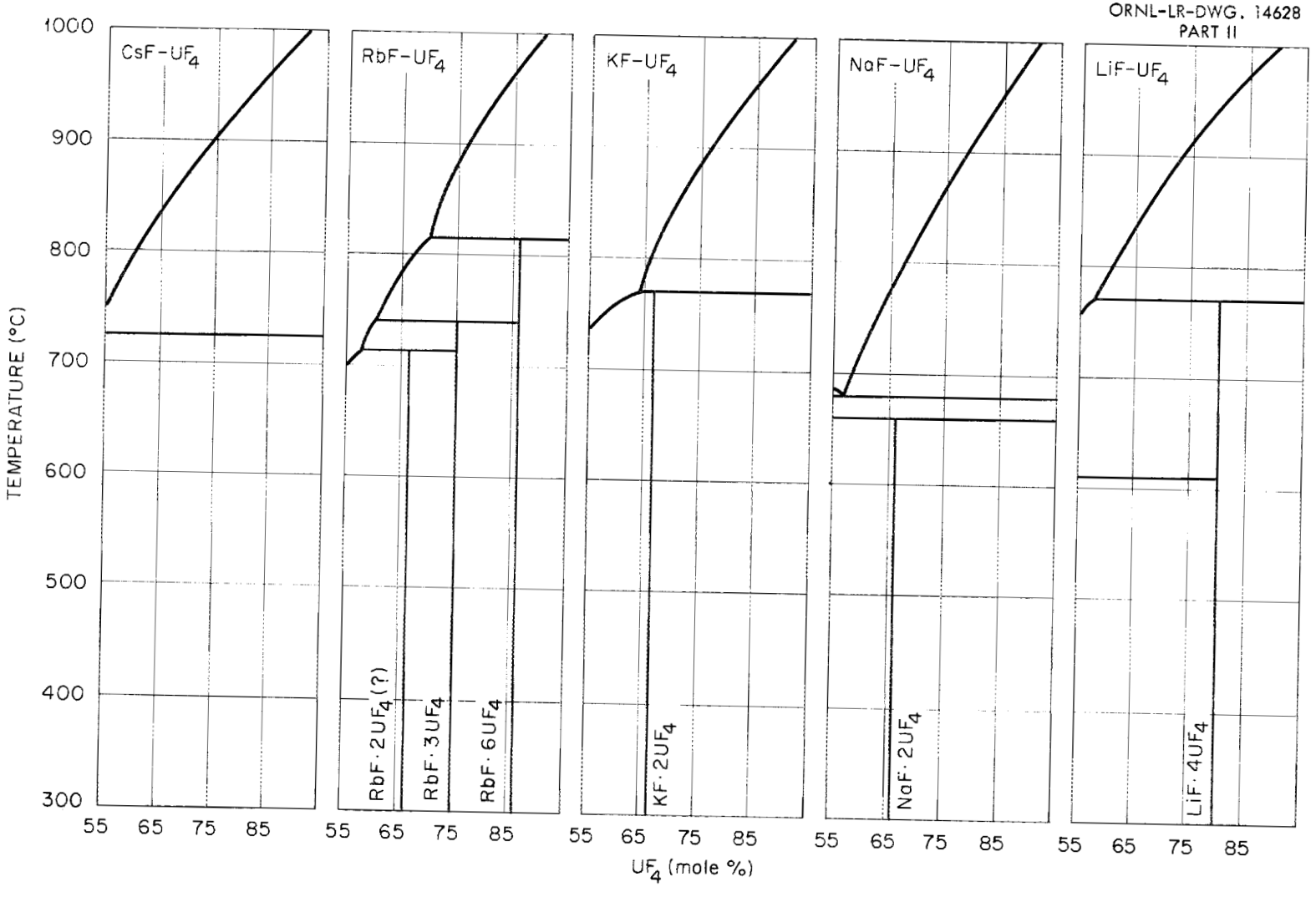
ORNL-LR-DWG. 14628
PART II



The Systems Alkali Fluorides—UF_4.

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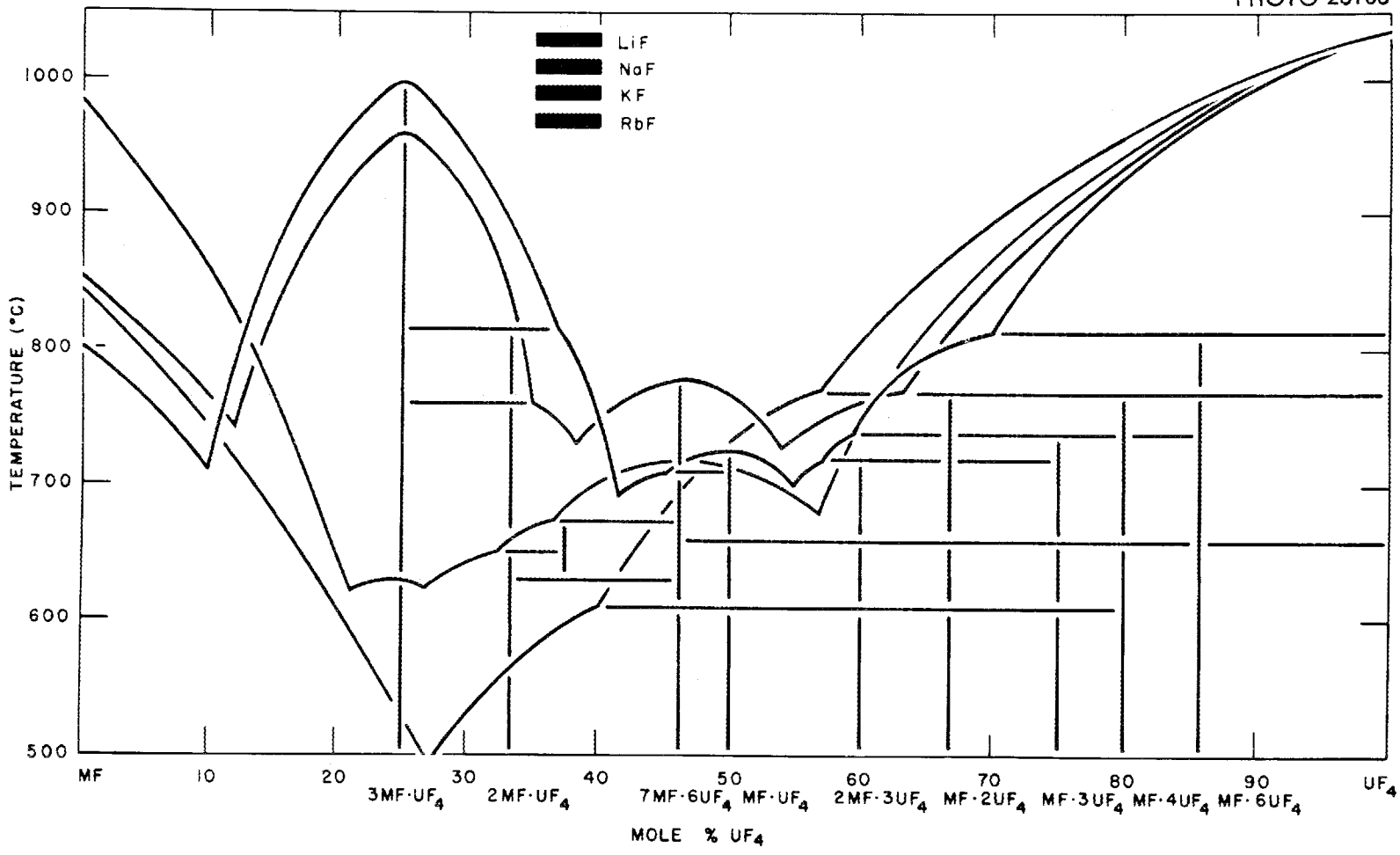
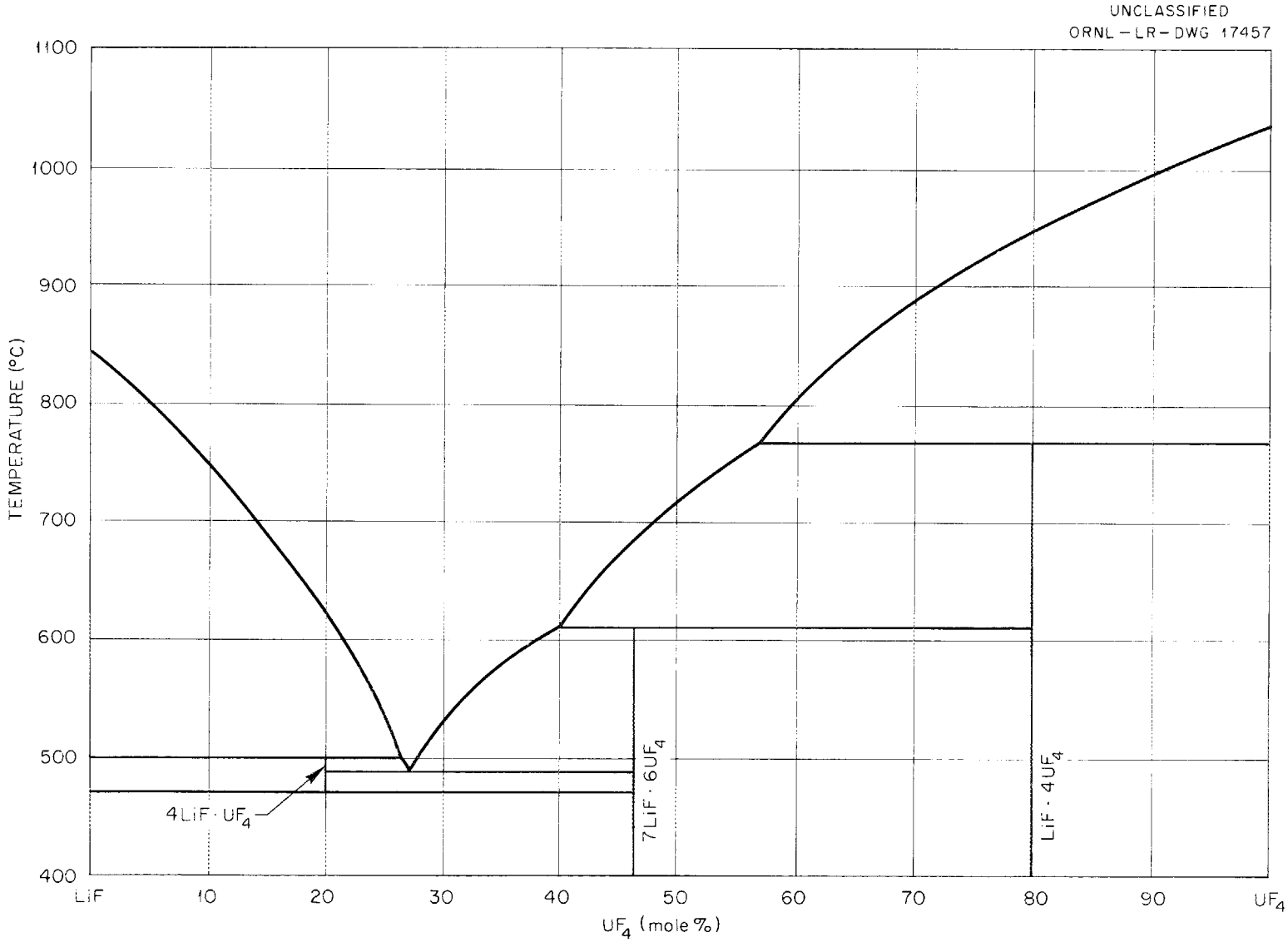
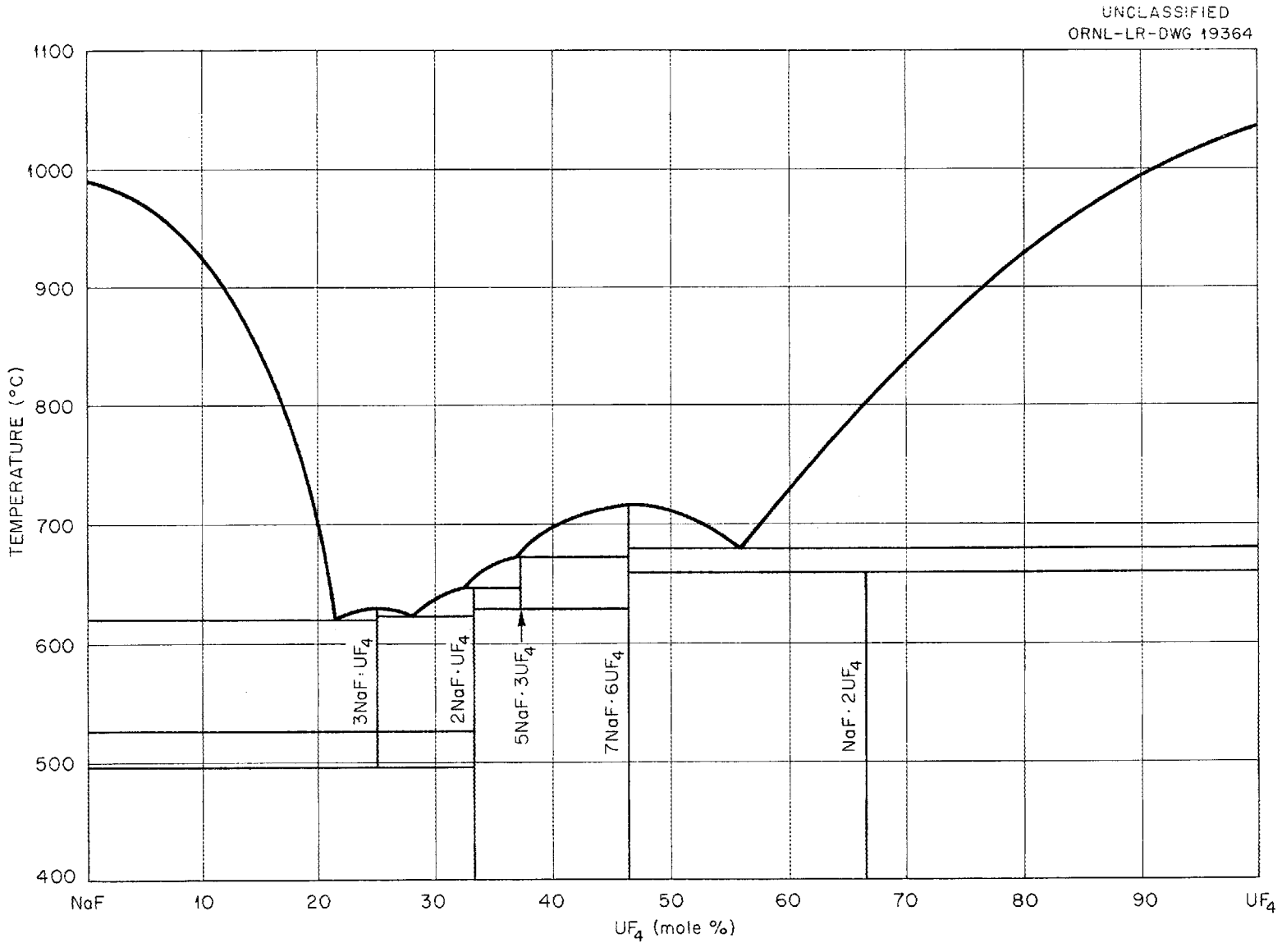
PHOTO 26106



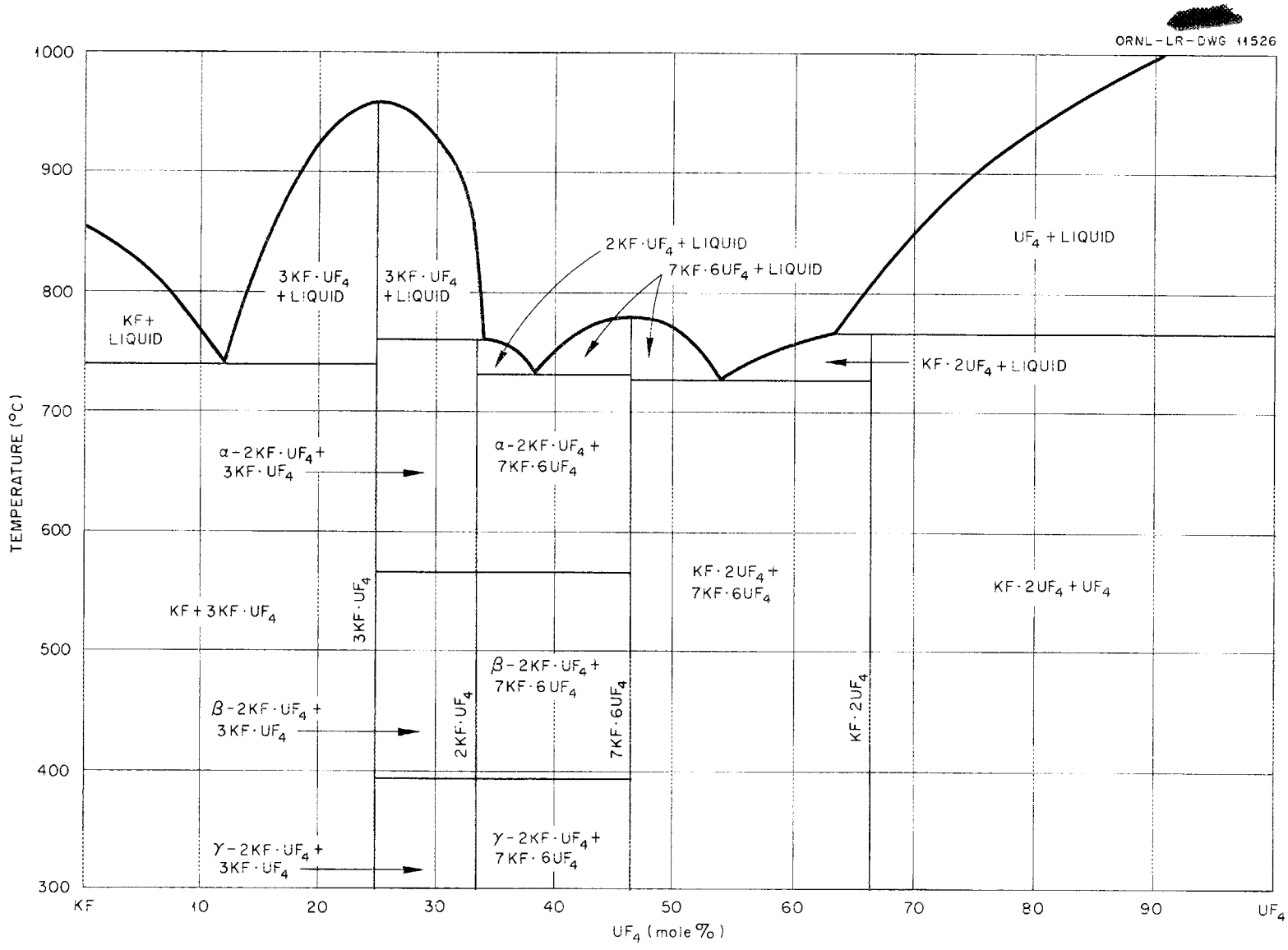
The Systems Alkali Fluorides—UF_4.



The System LiF–UF_4.



The System NaF–UF_4.



The System KF–UF_4.

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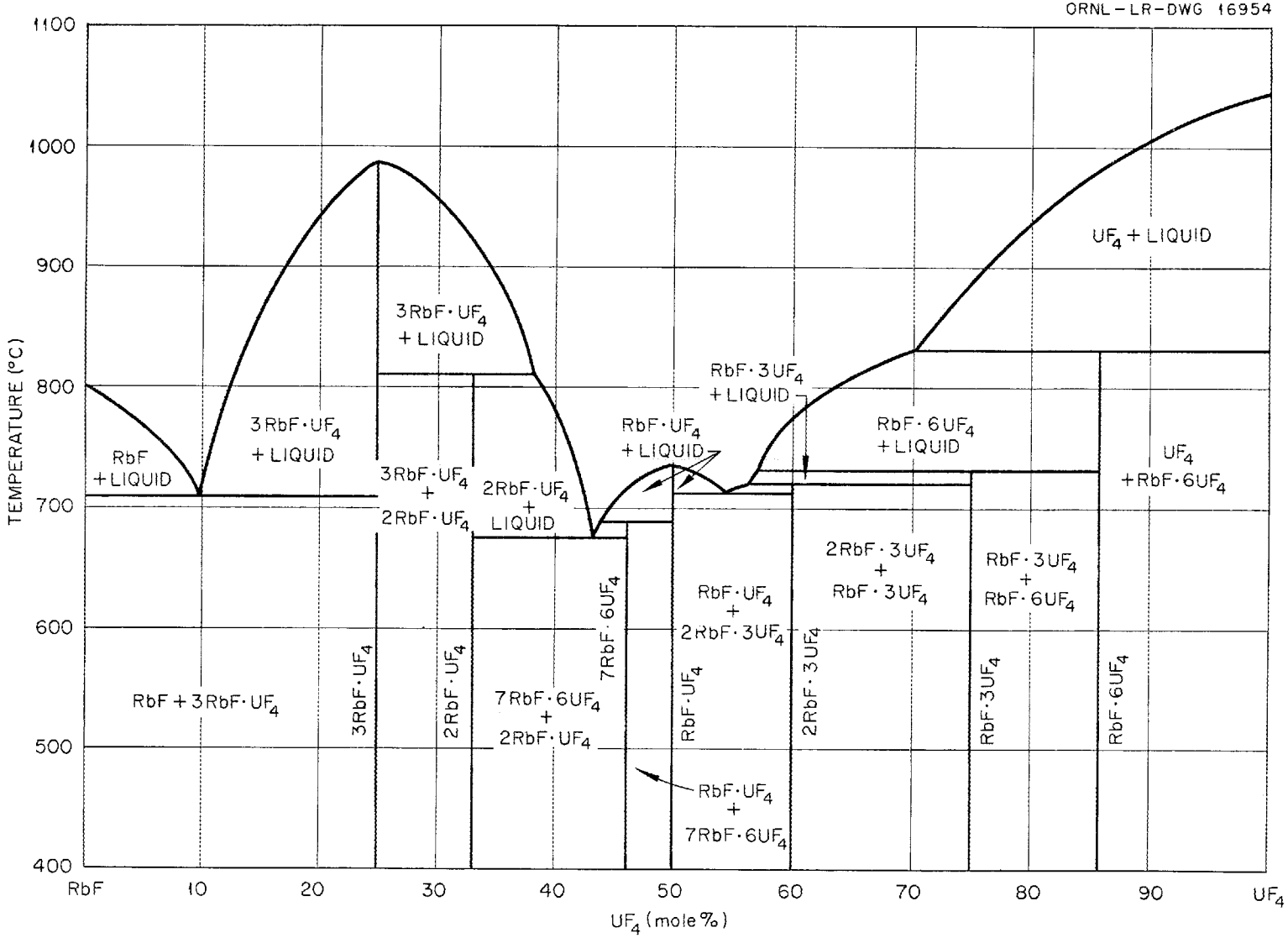
ORNL-LR-DWG 16954



The System RbF–UF_4.

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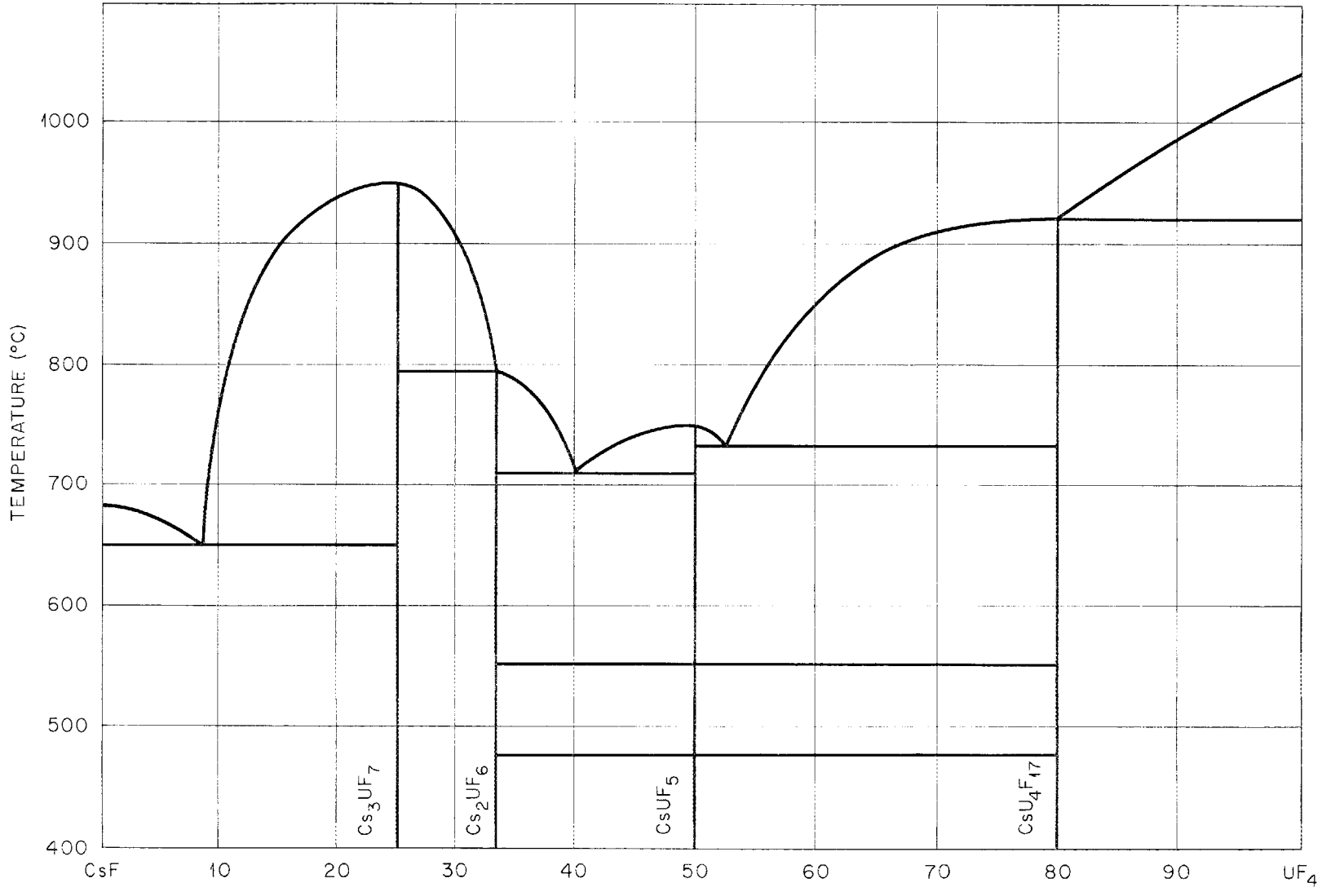
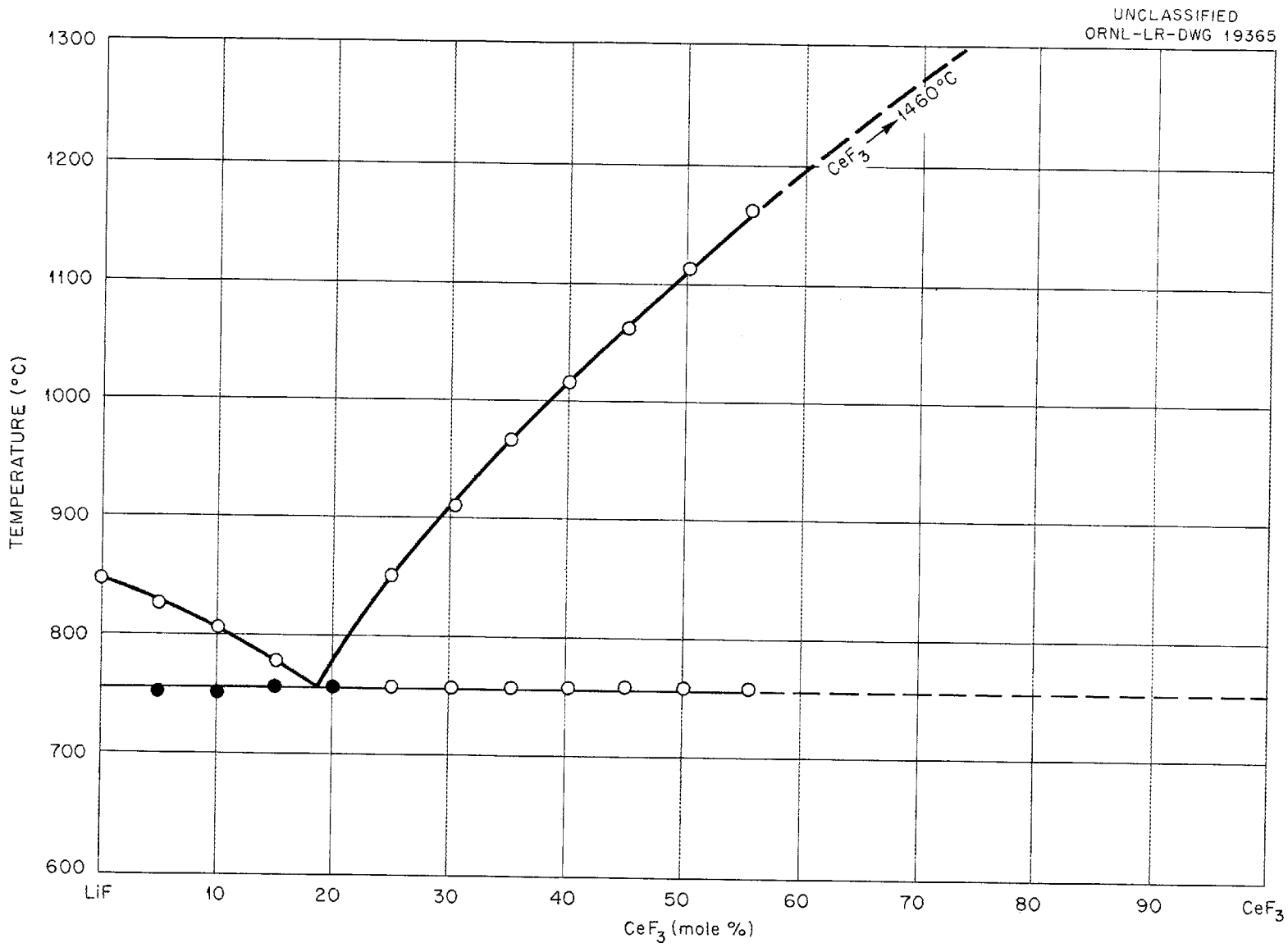
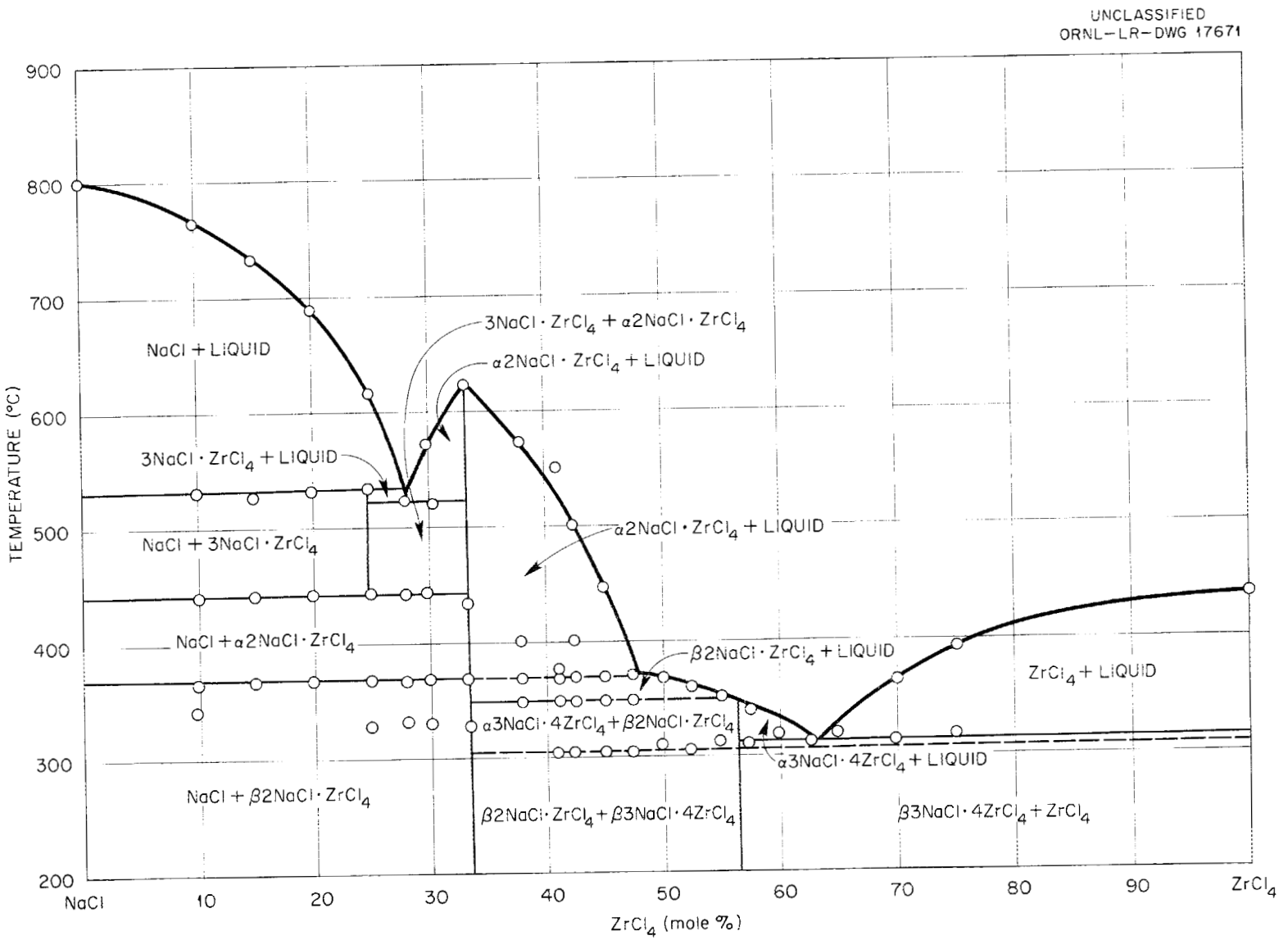


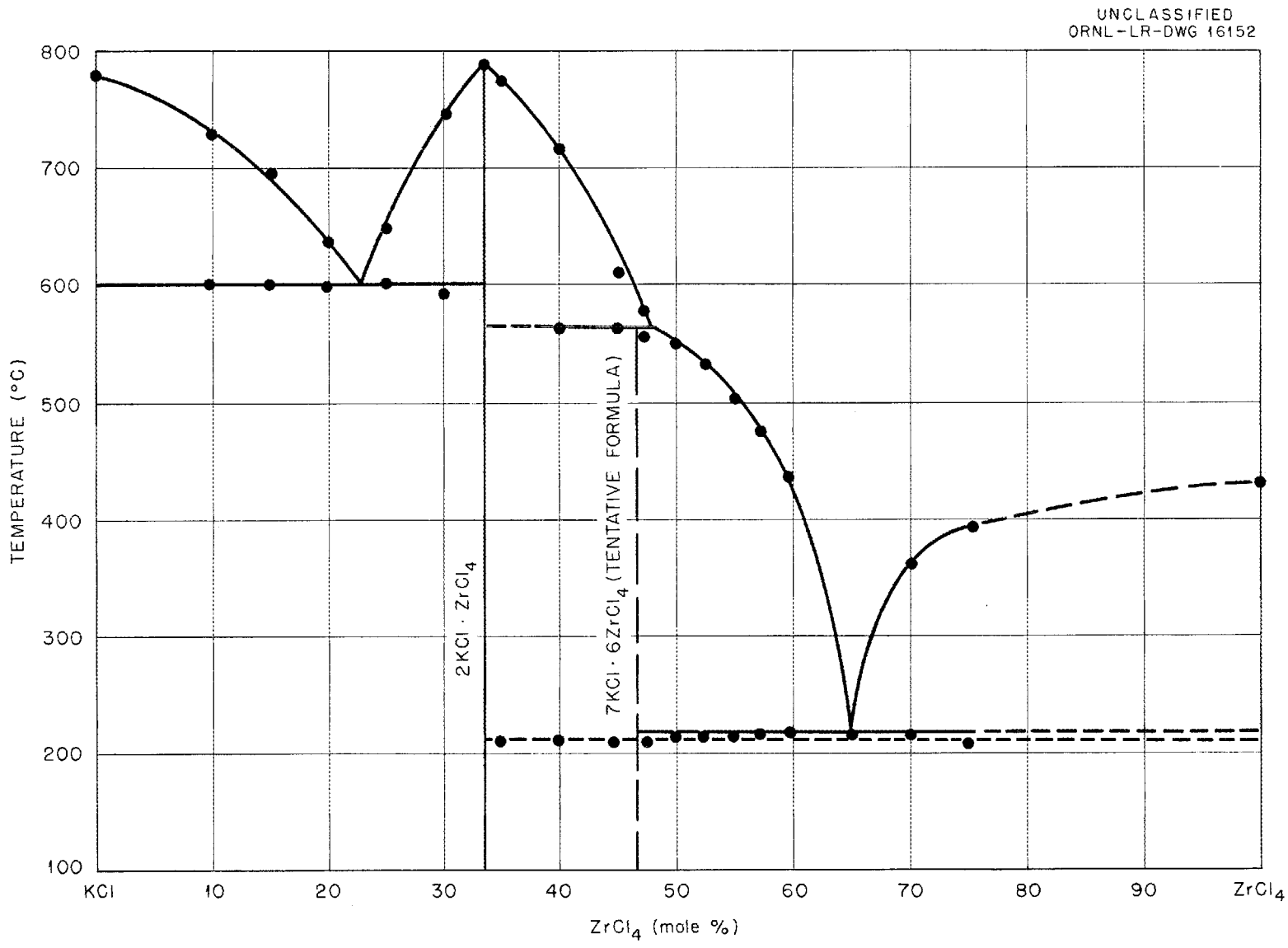
The System CsF–UF_4.



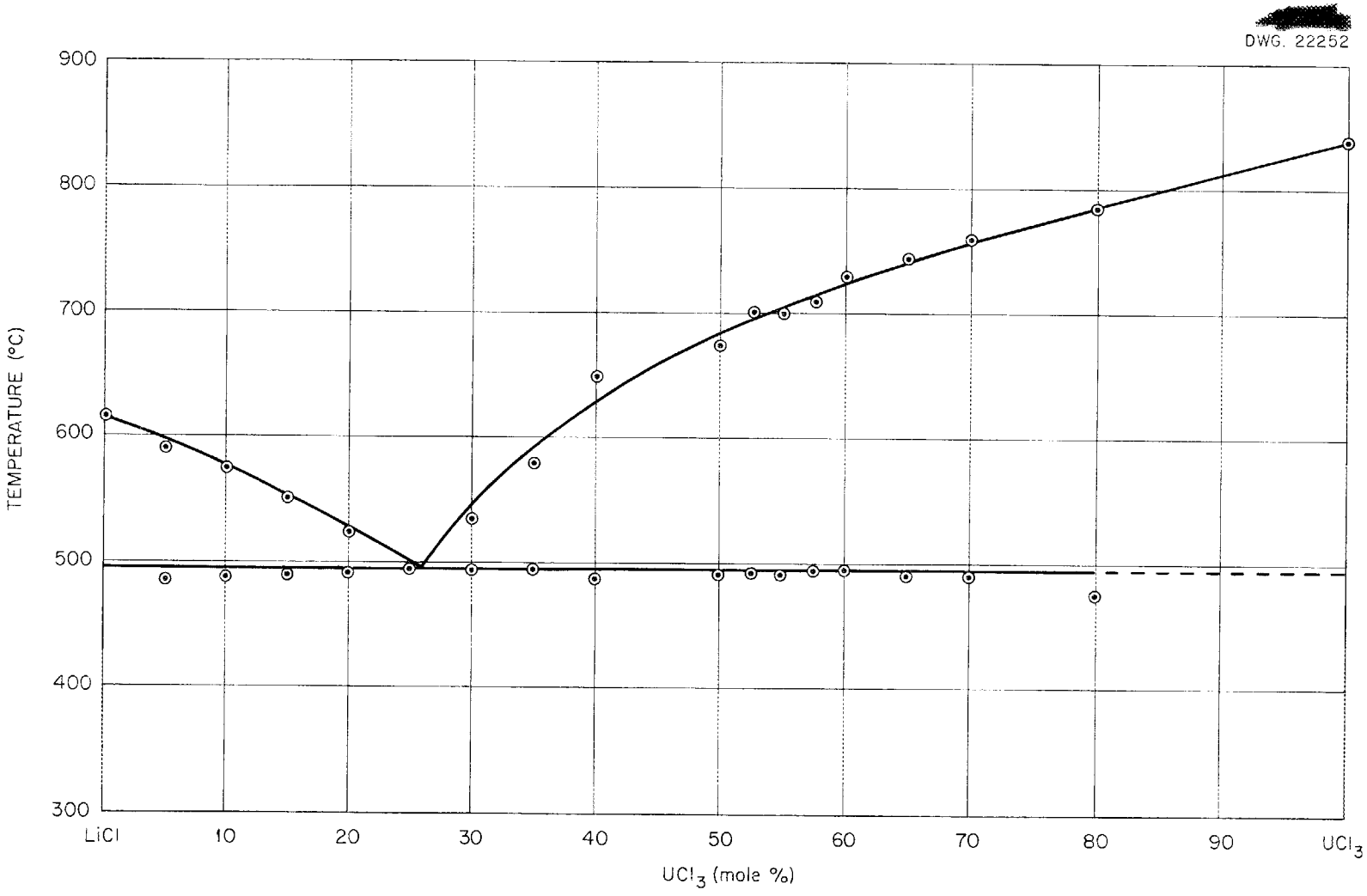
The System LiF–CeF_3.



The System NaCl–$ZrCl_4$.



The System $KCl–ZrCl_4$.



The System $LiCl-UCl_3$.

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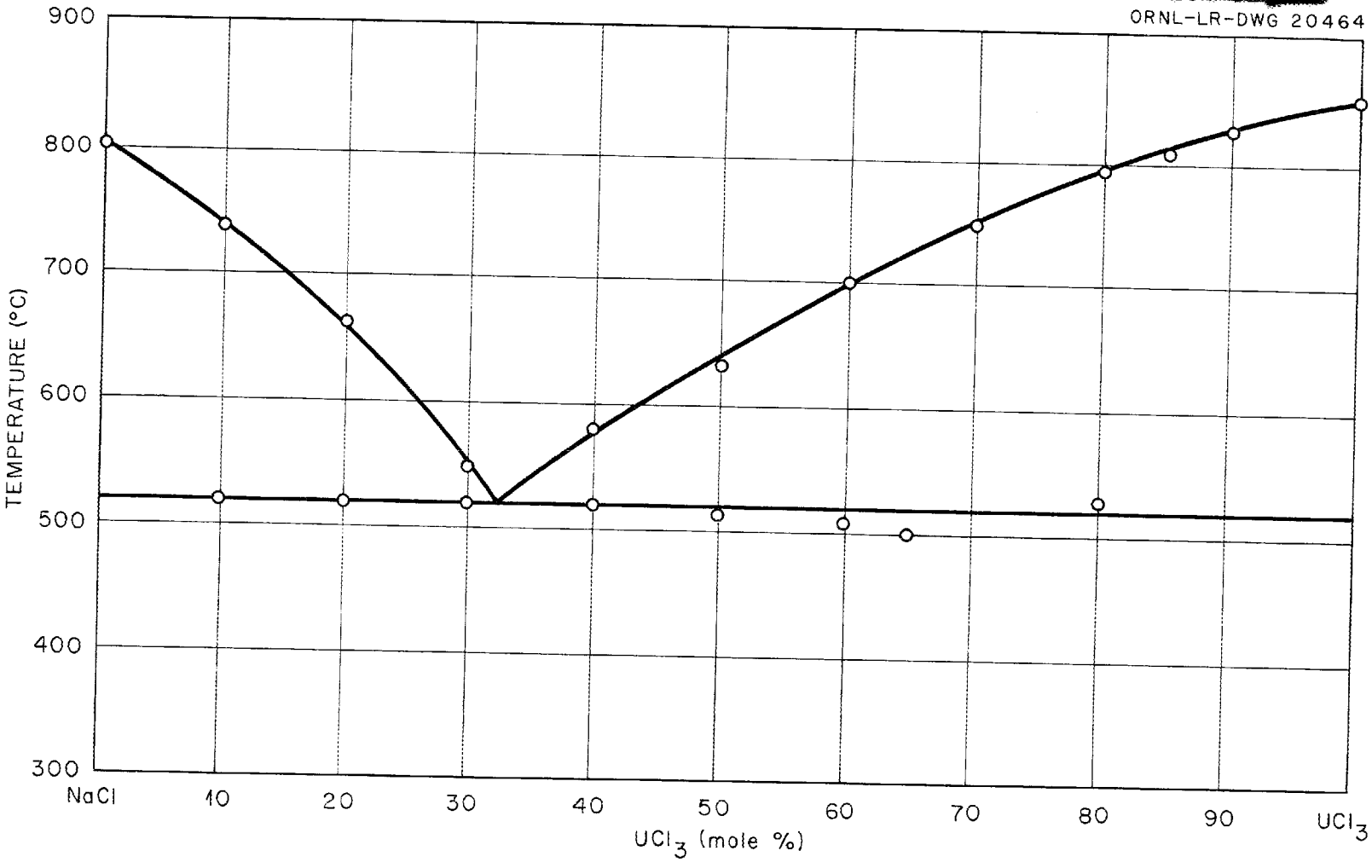
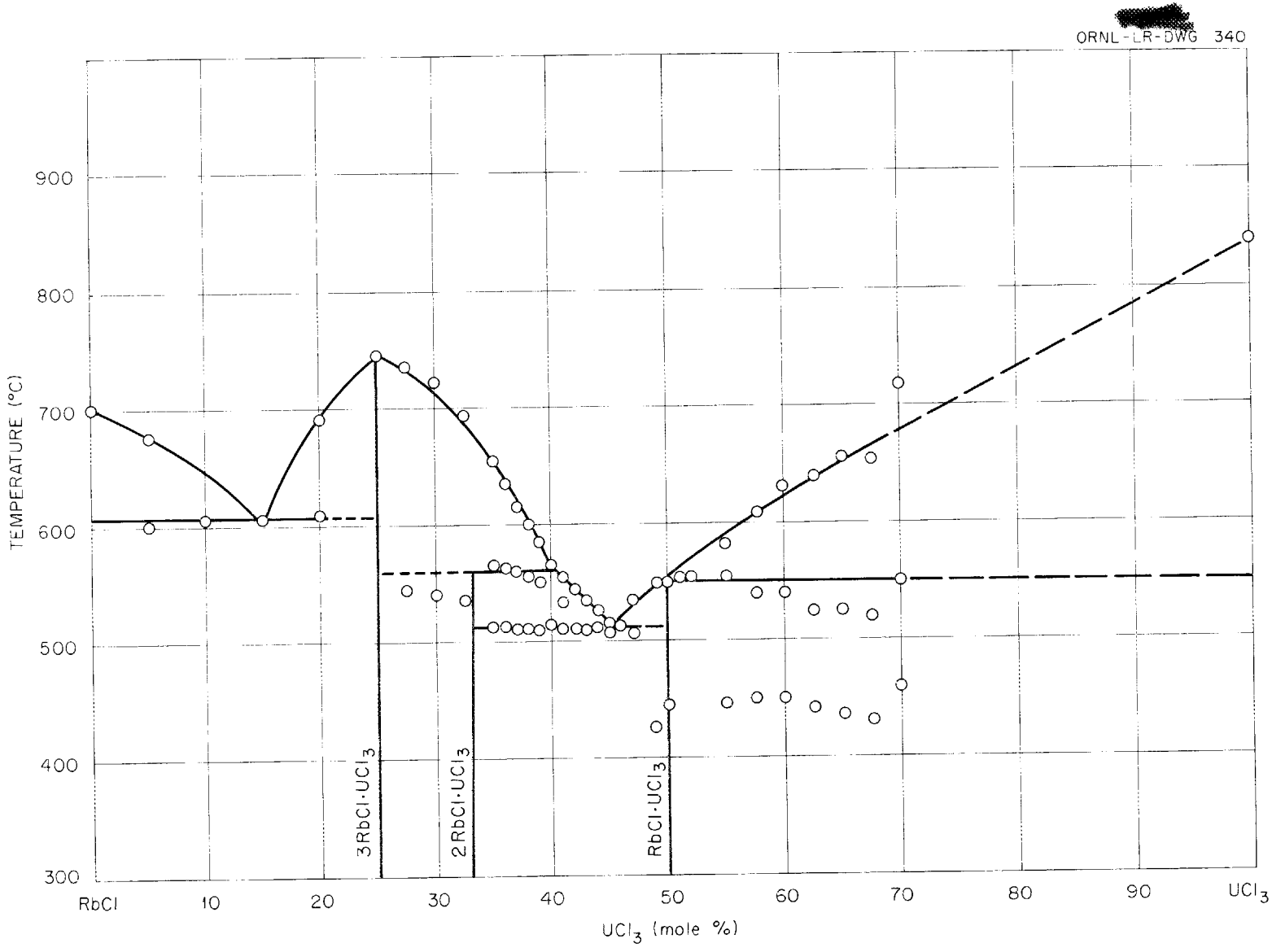


The System $NaCl-UCl_3$.



The System RbCl–UCl_3.

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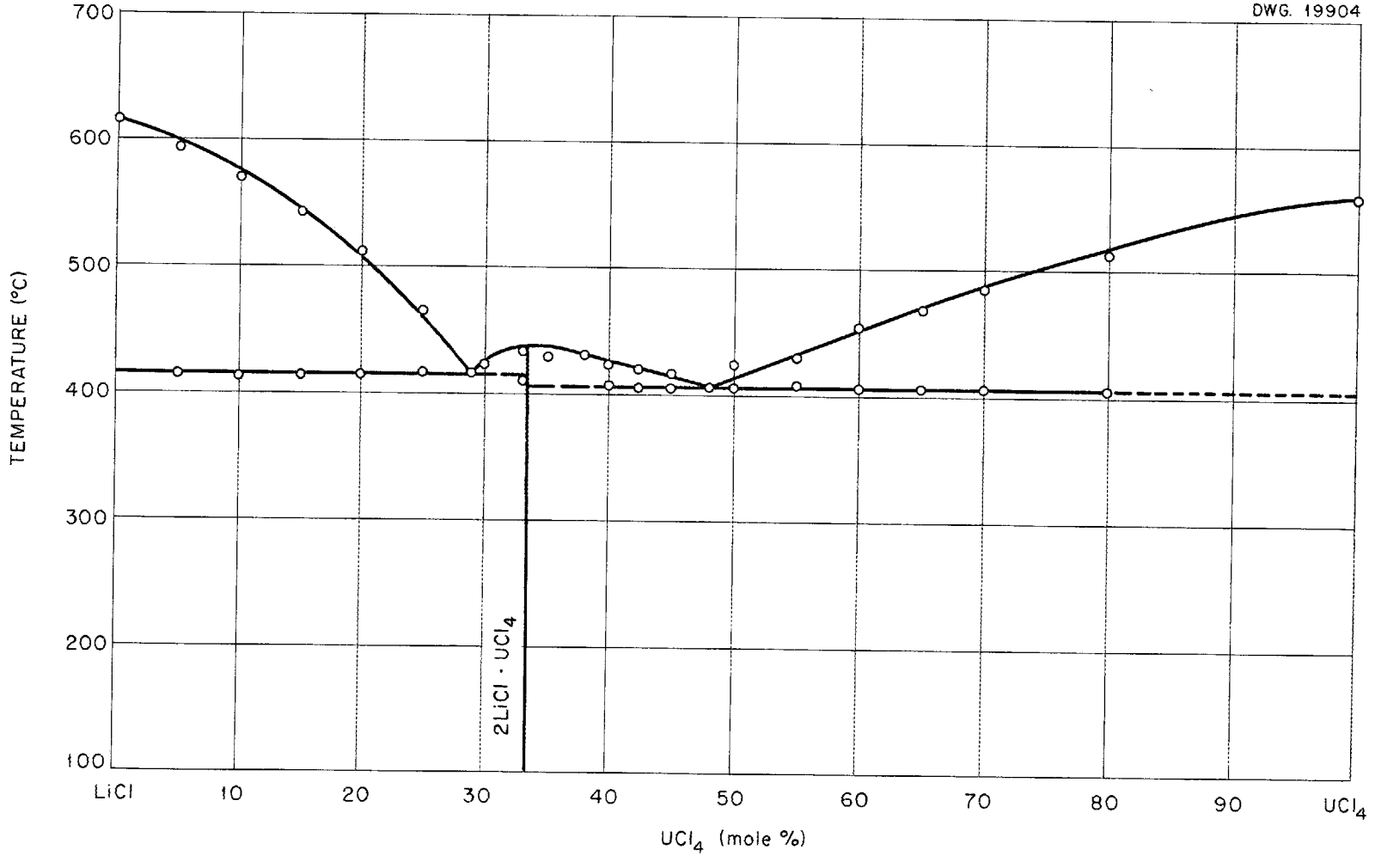

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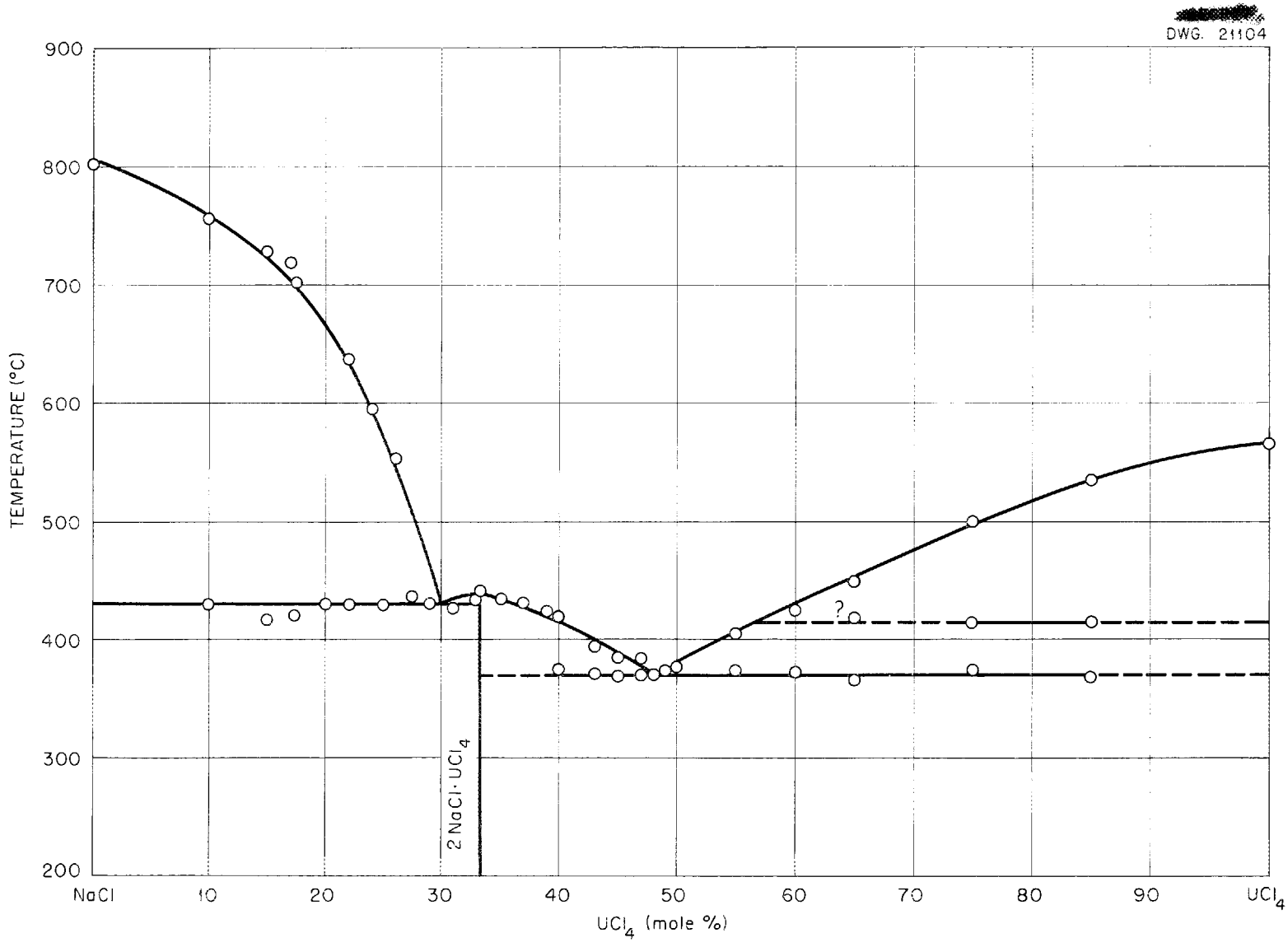

The System $NaCl-UCl_4$.

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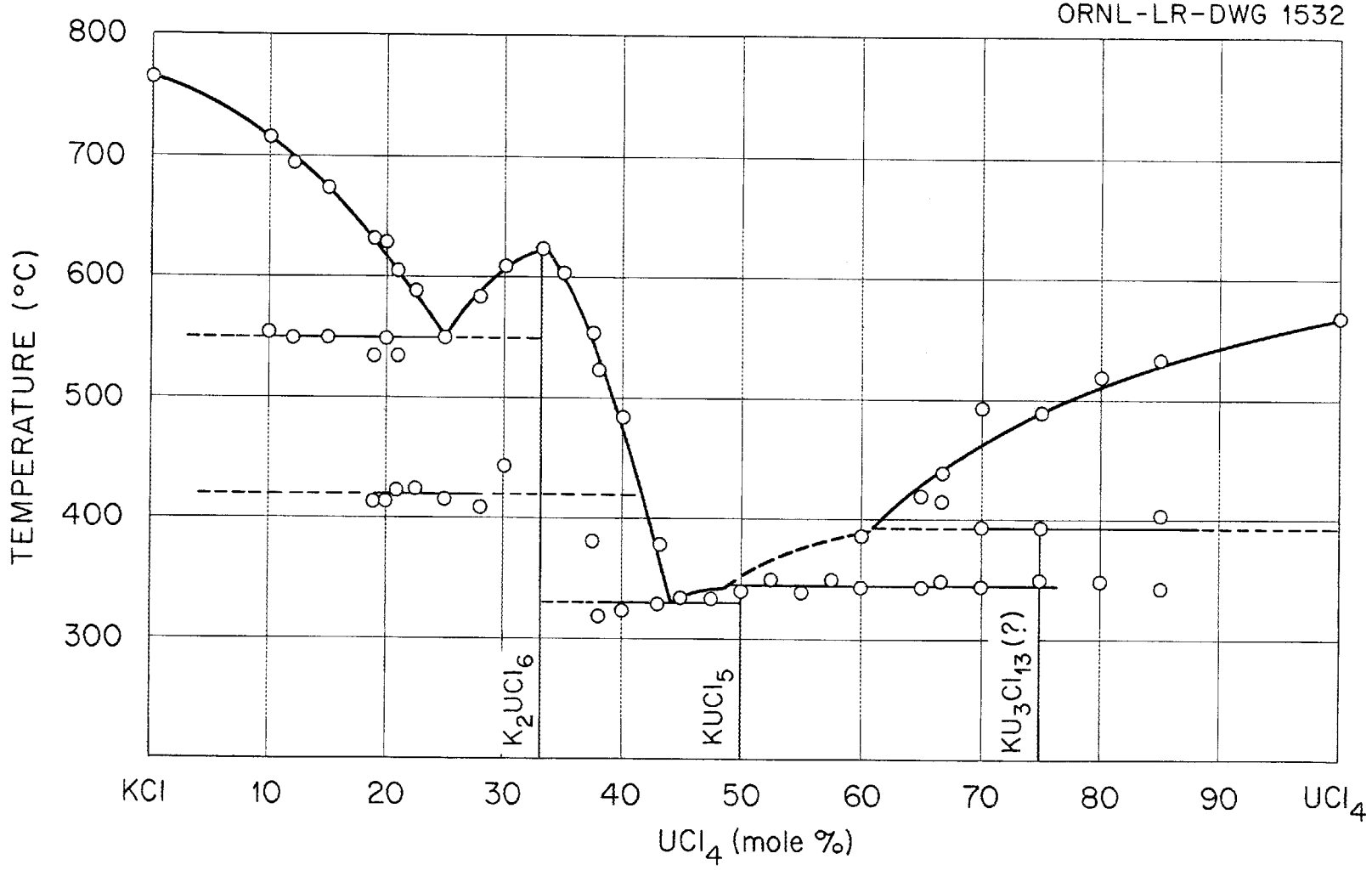
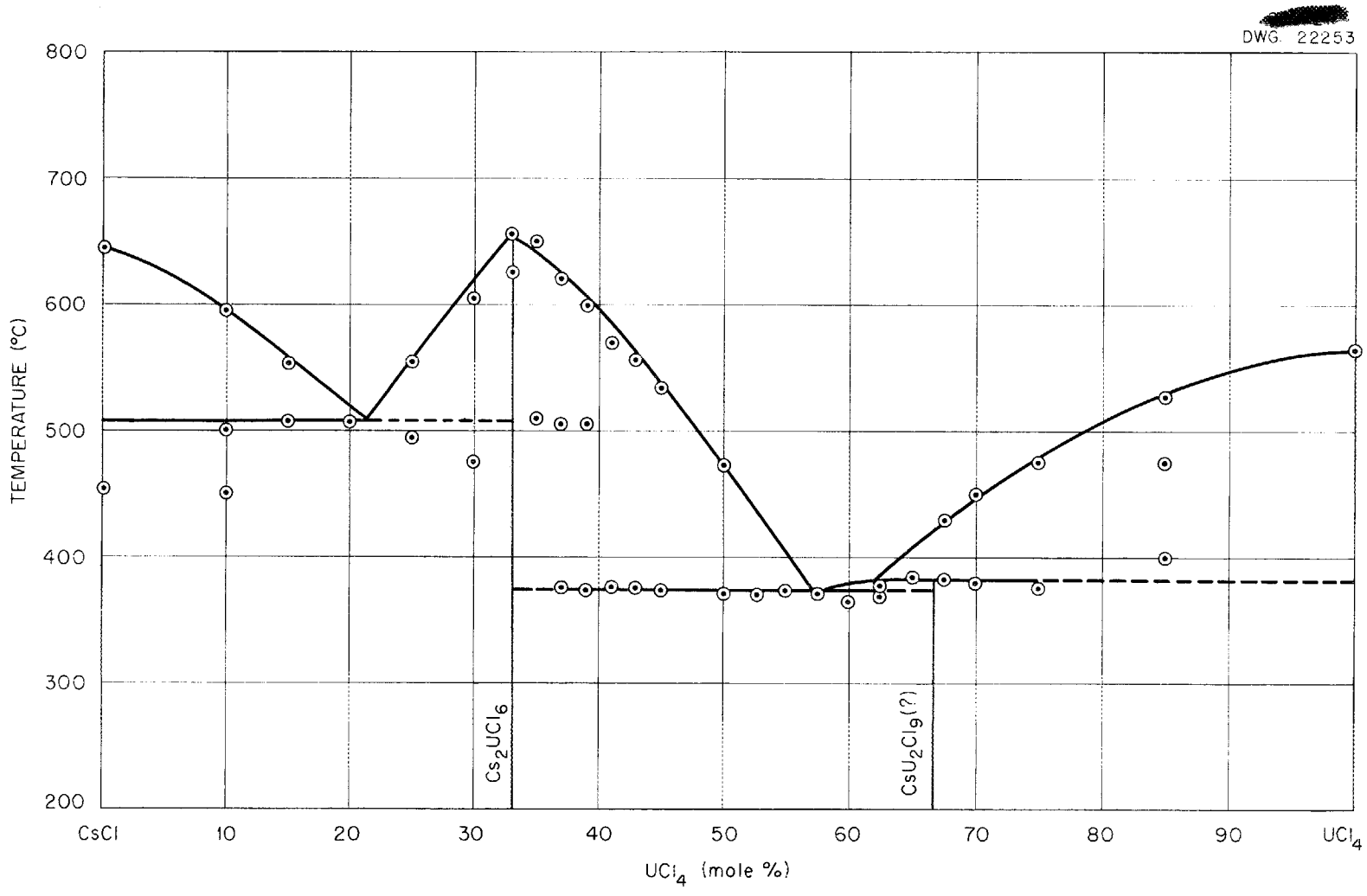


The System KCl–UCl_4.



The System $CsCl–UCl_4$.

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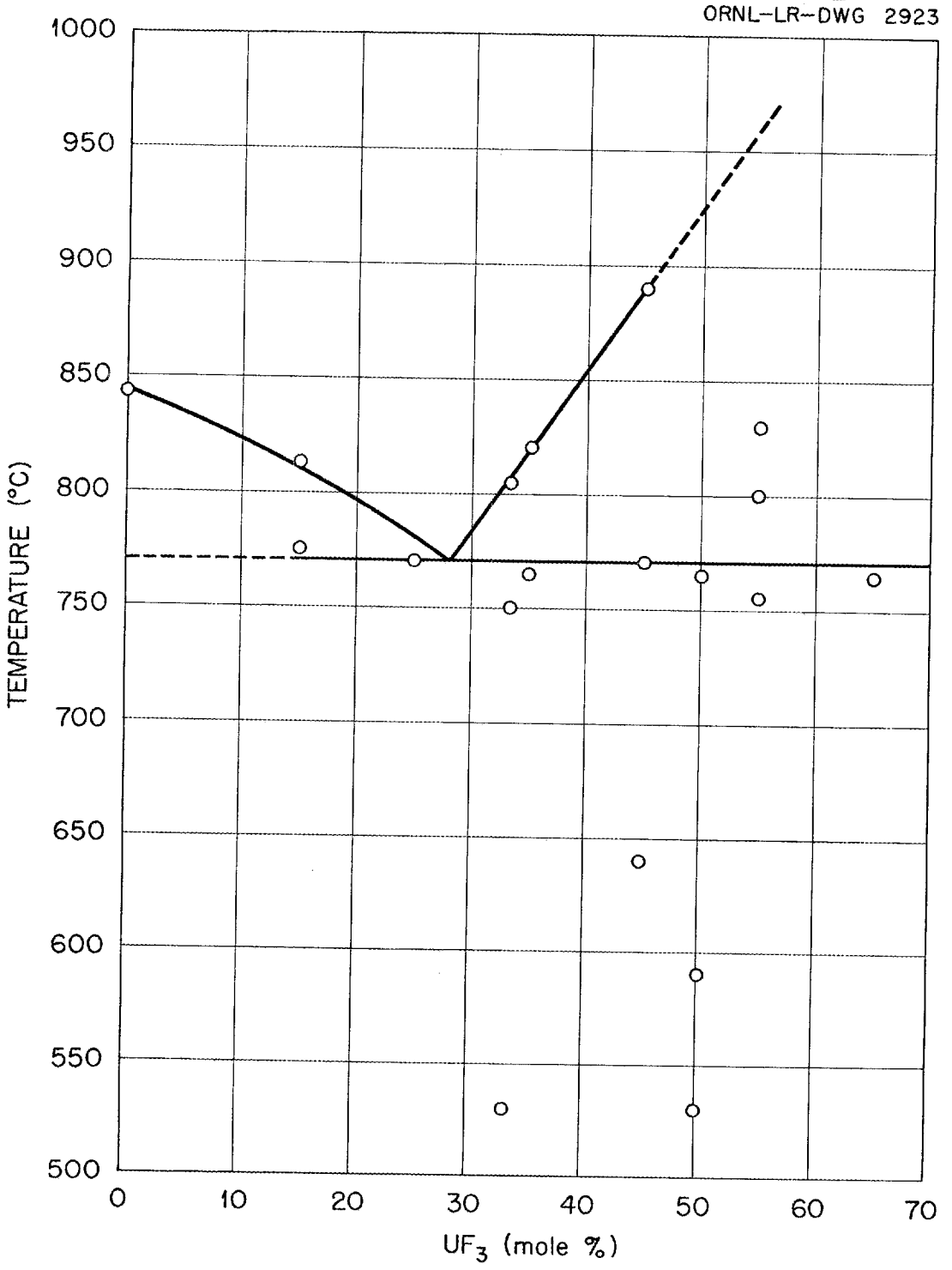

The System LiF–UF_3.

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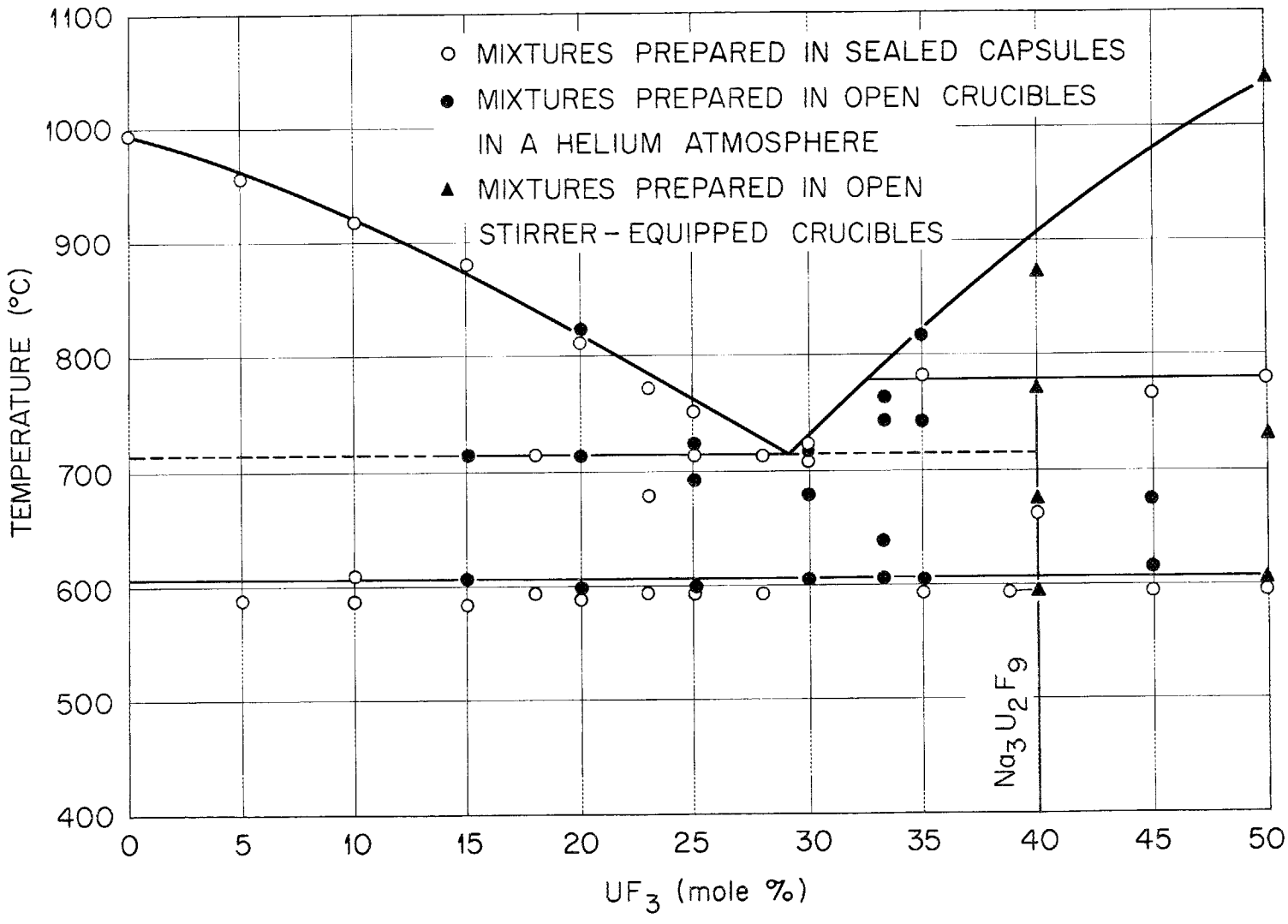
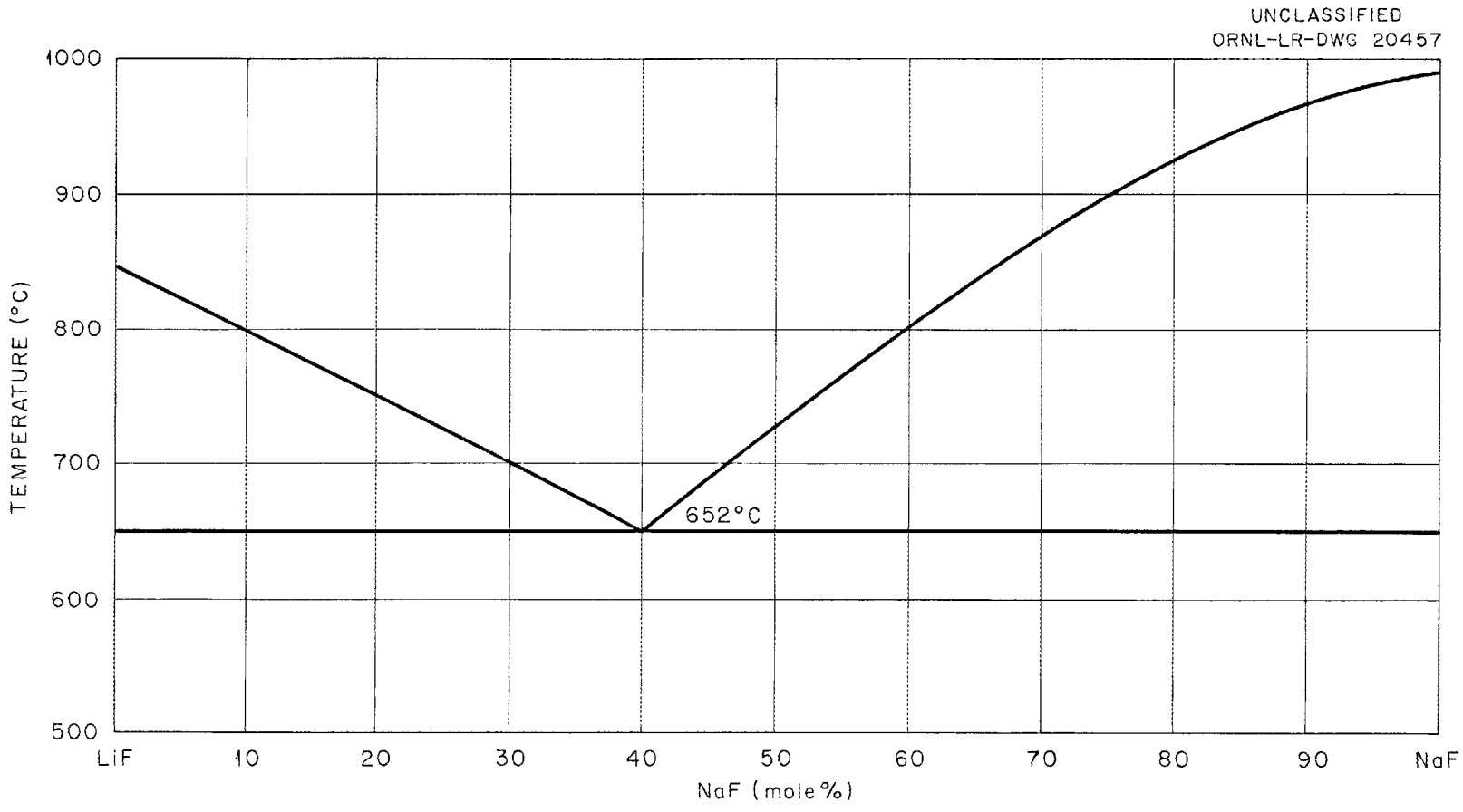
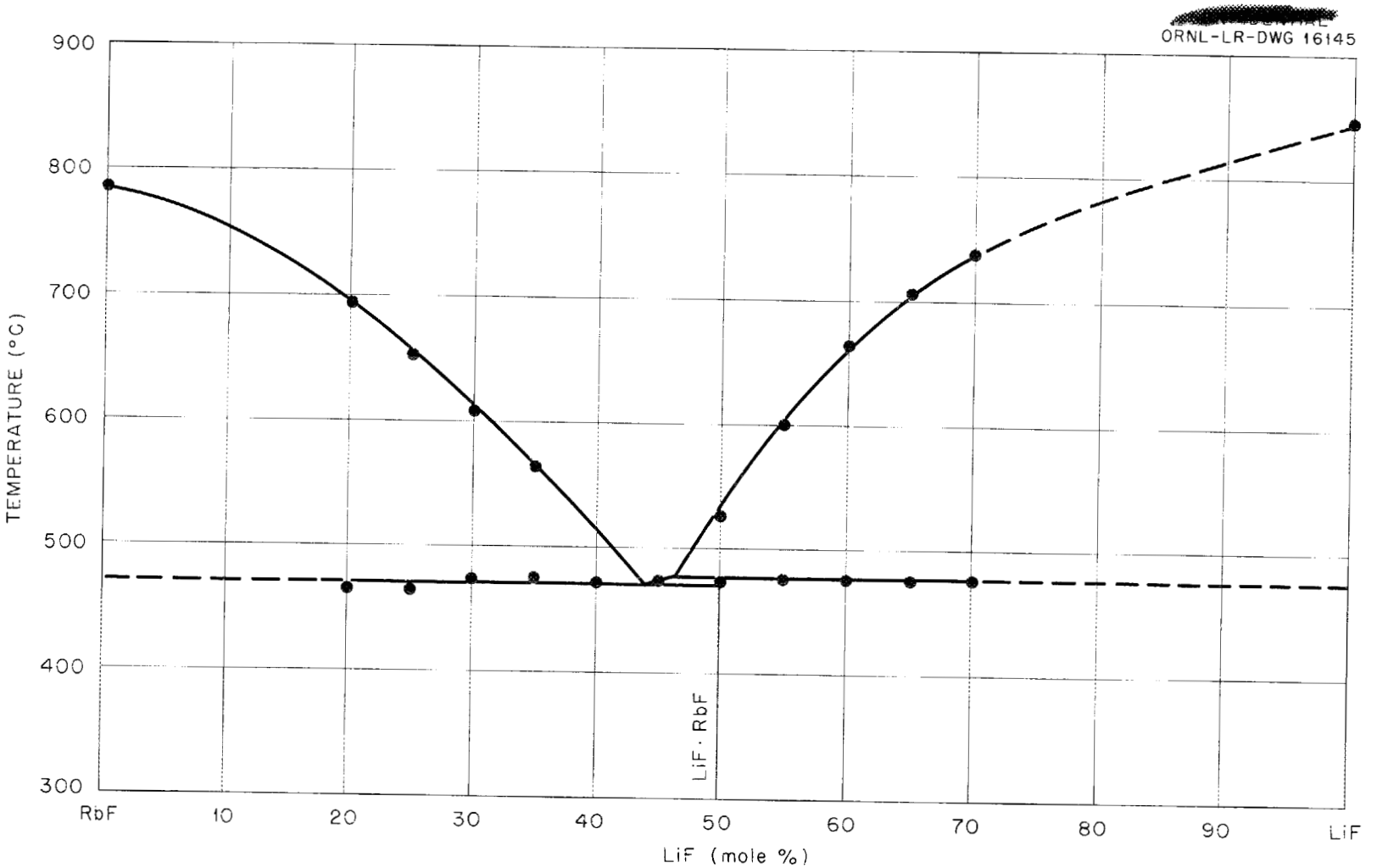
ORNL-LR-DWG 2924



The System NaF–UF_3.



The System LiF–NaF.



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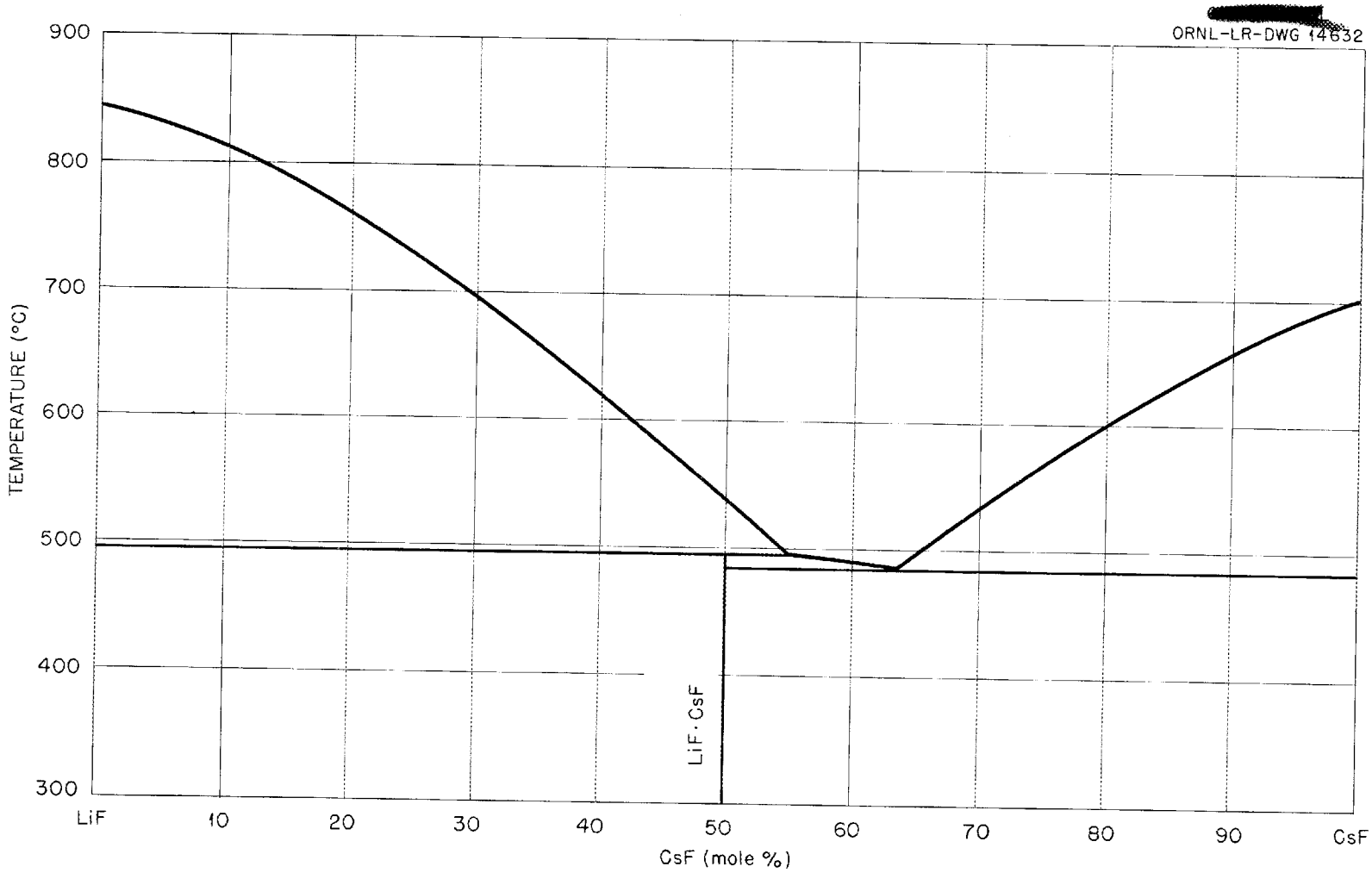

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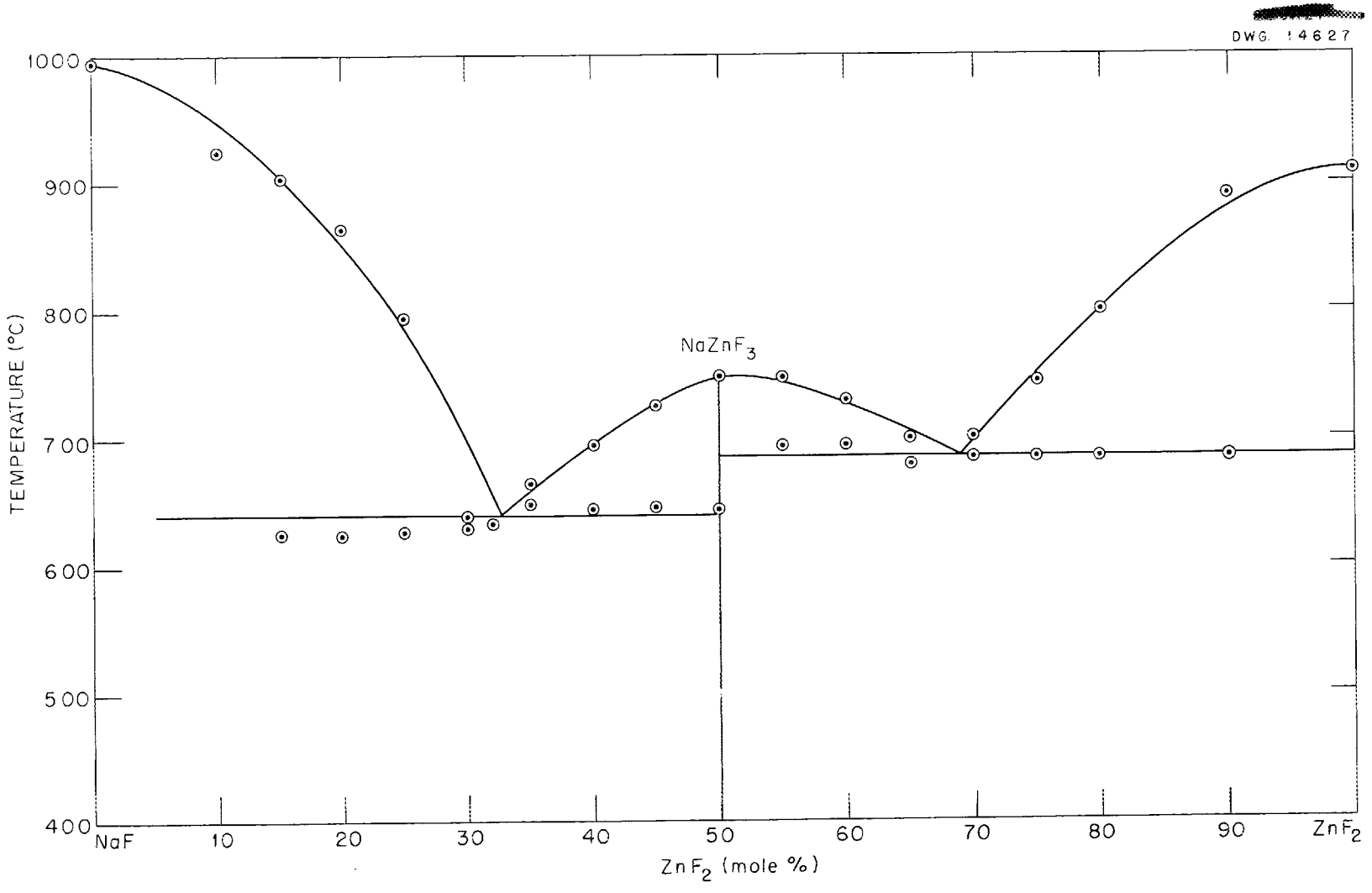
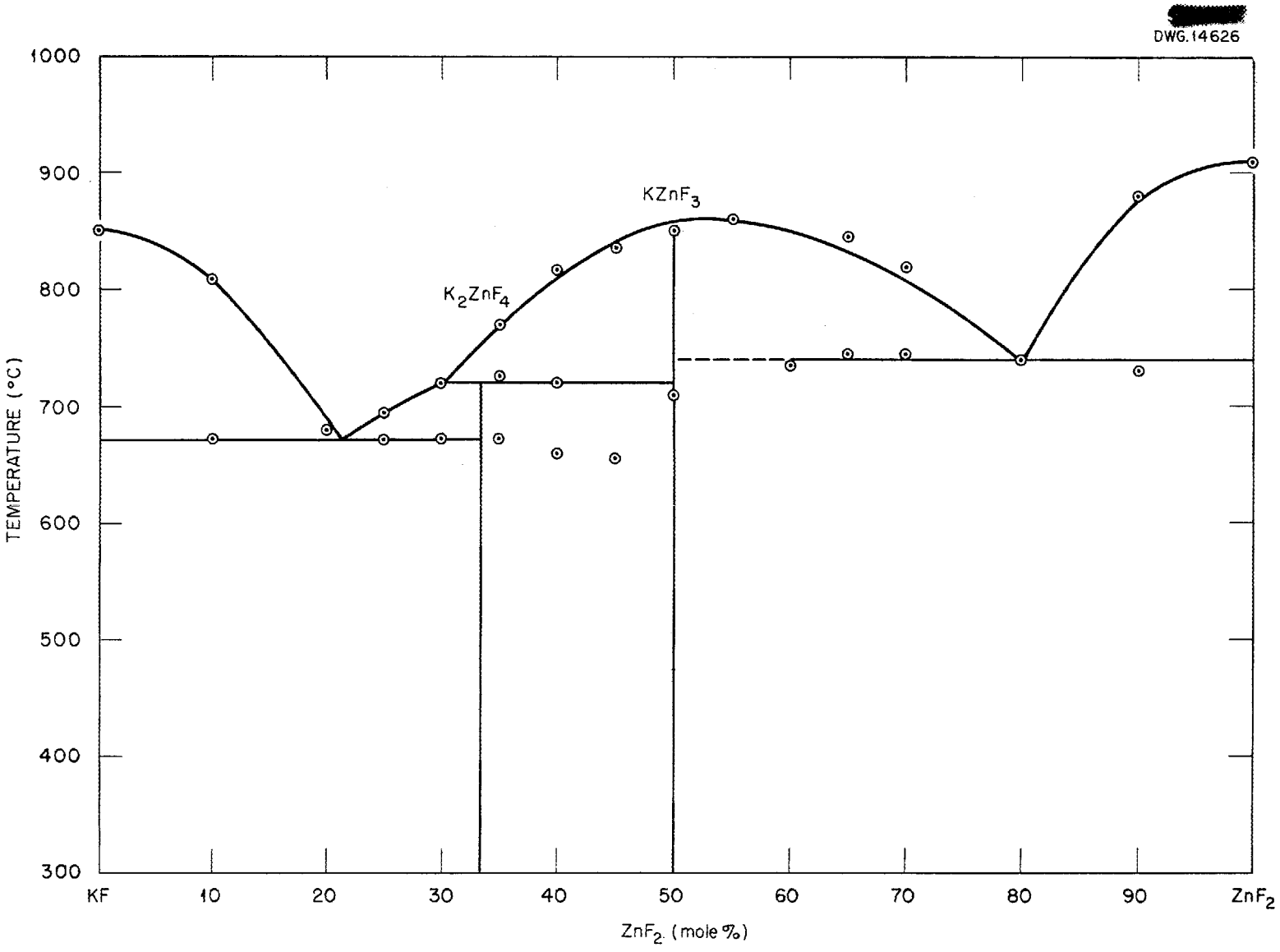
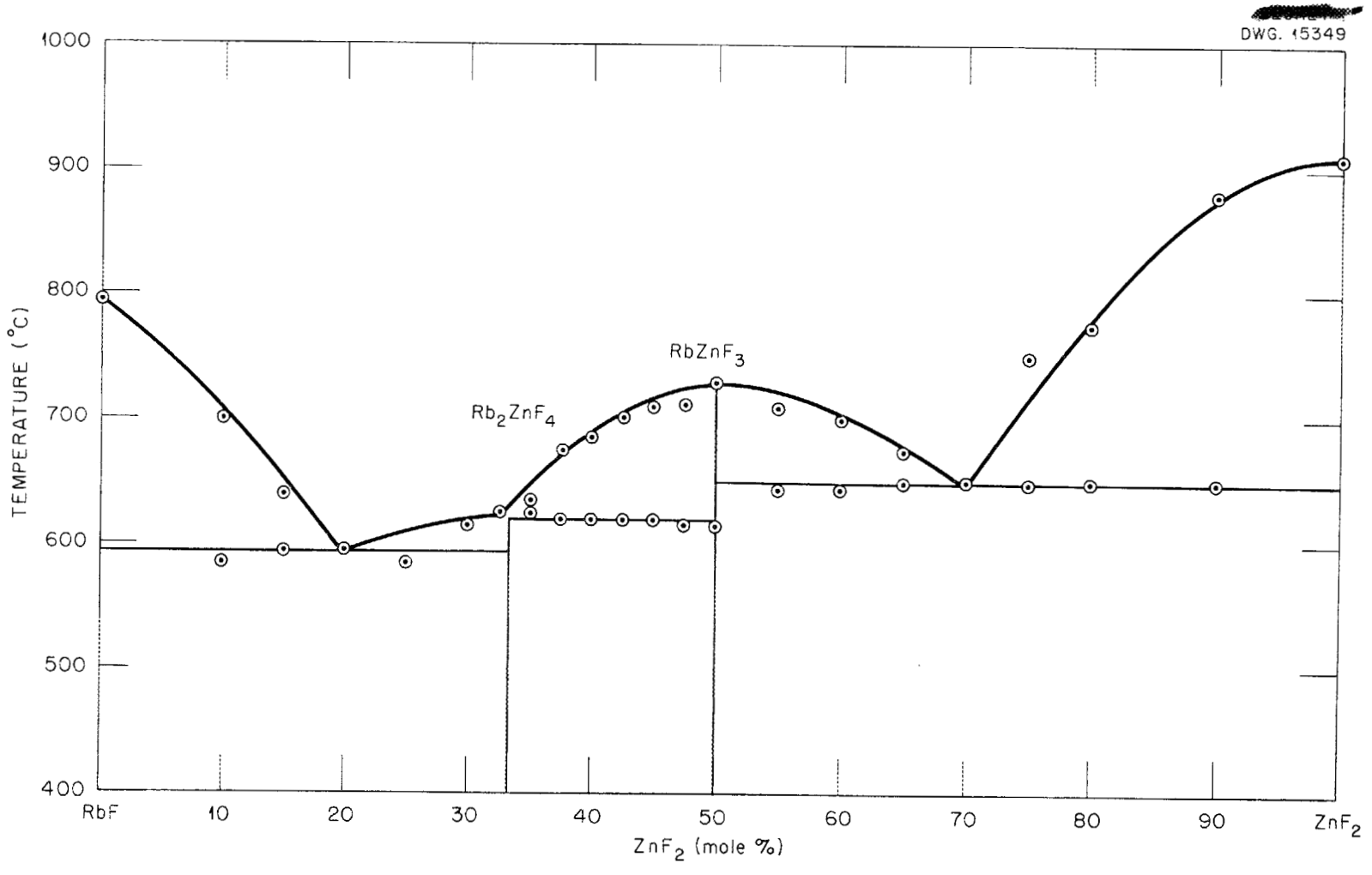


The System $NaF-ZnF_2$.



The System KF–ZnF_2.



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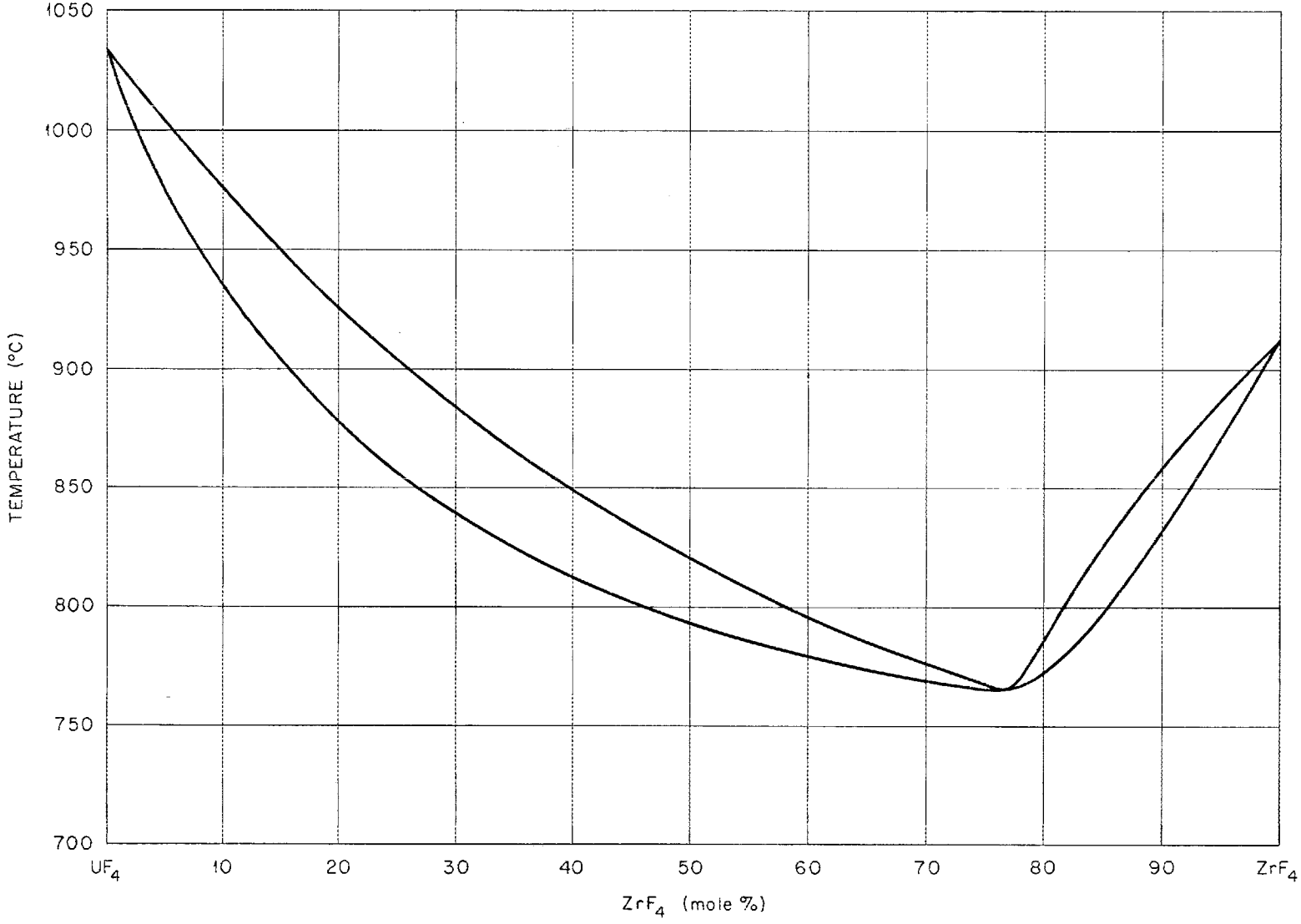
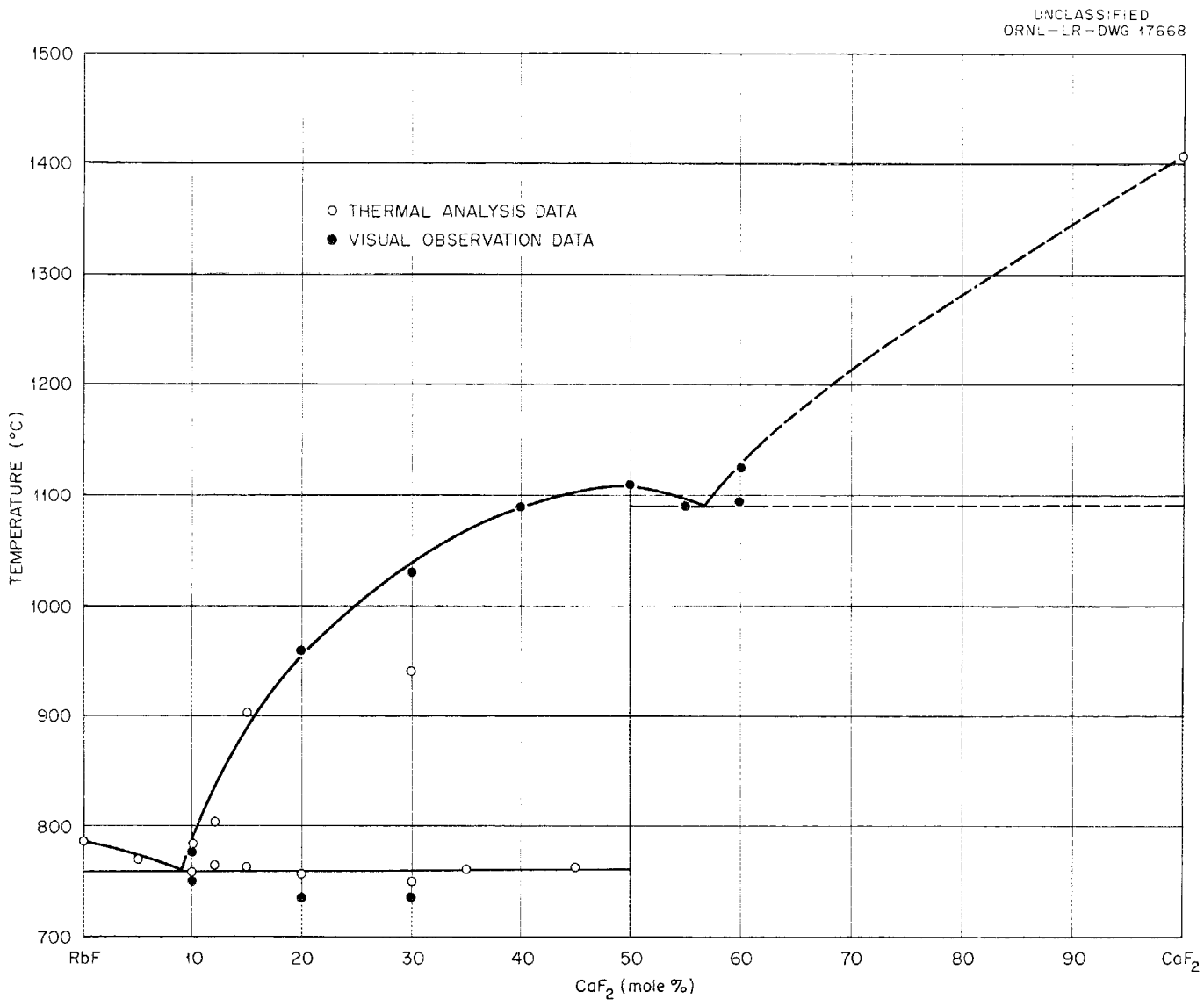
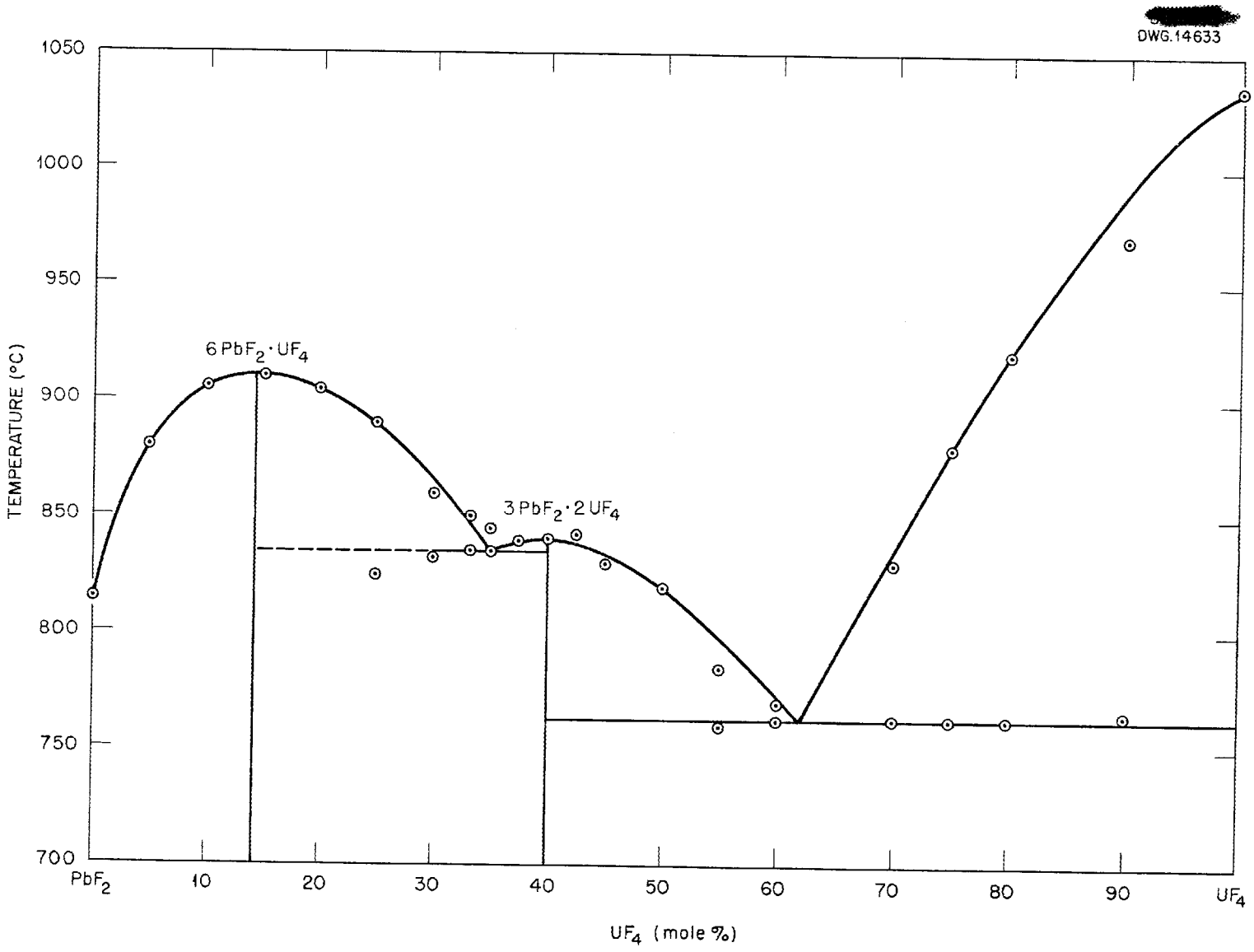


The System UF_4–ZrF_4.



The System RbF–CaF_2.



The System PbF_2–UF_4.

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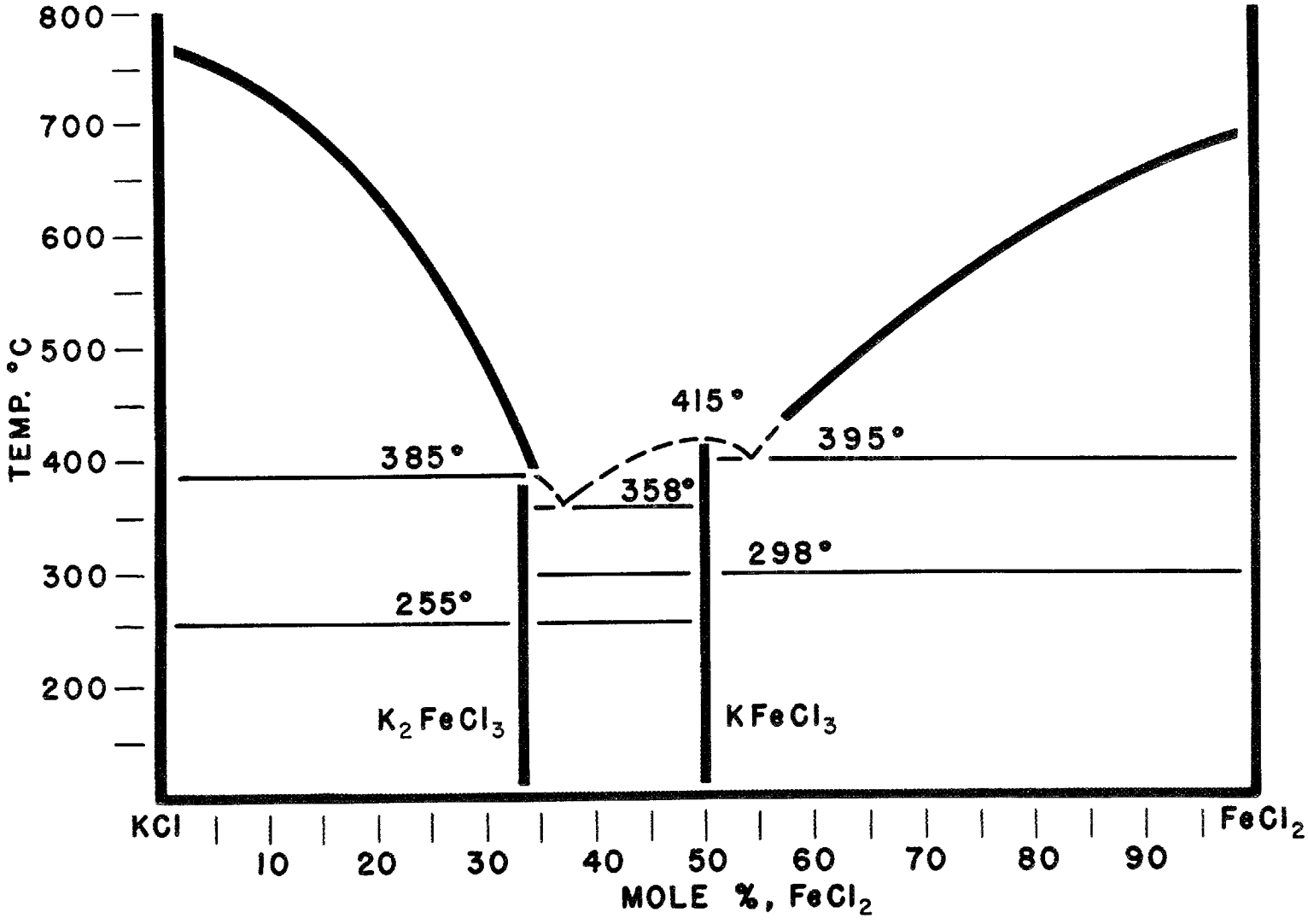
PHOTO 26016



The System KCl–$FeCl_2$.

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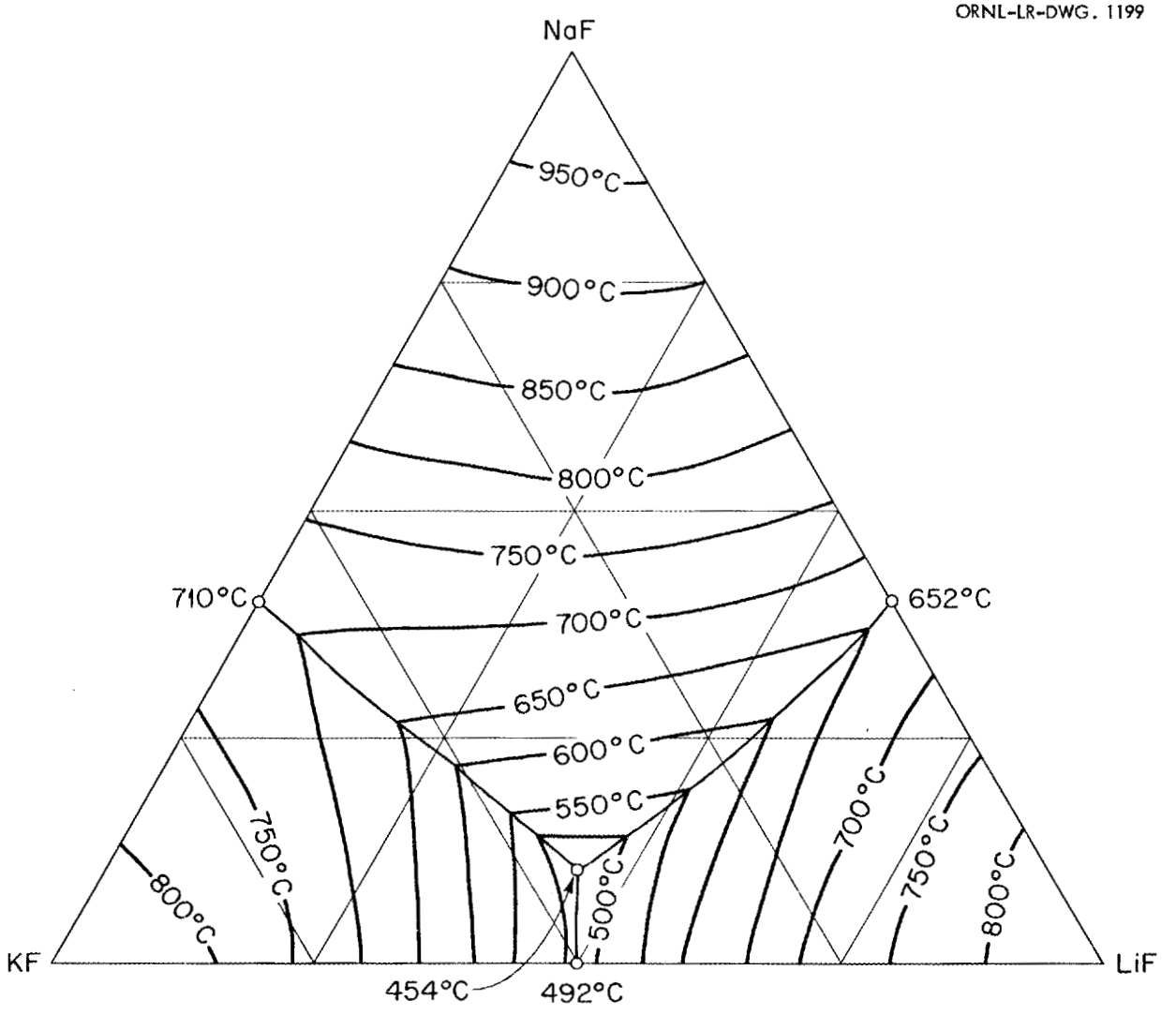
ORNL-LR-DWG. 1199



The System KF–LiF–NaF.

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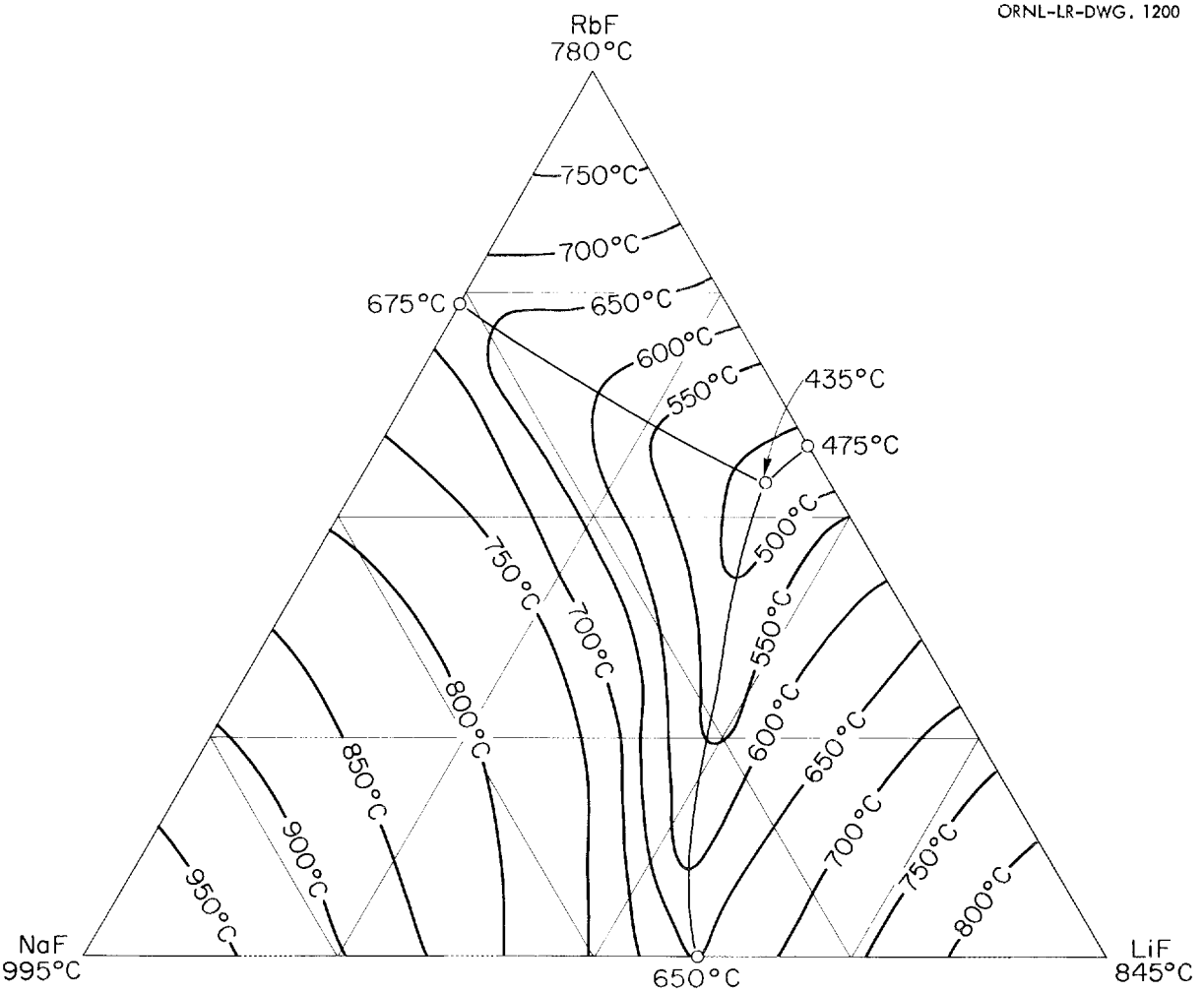
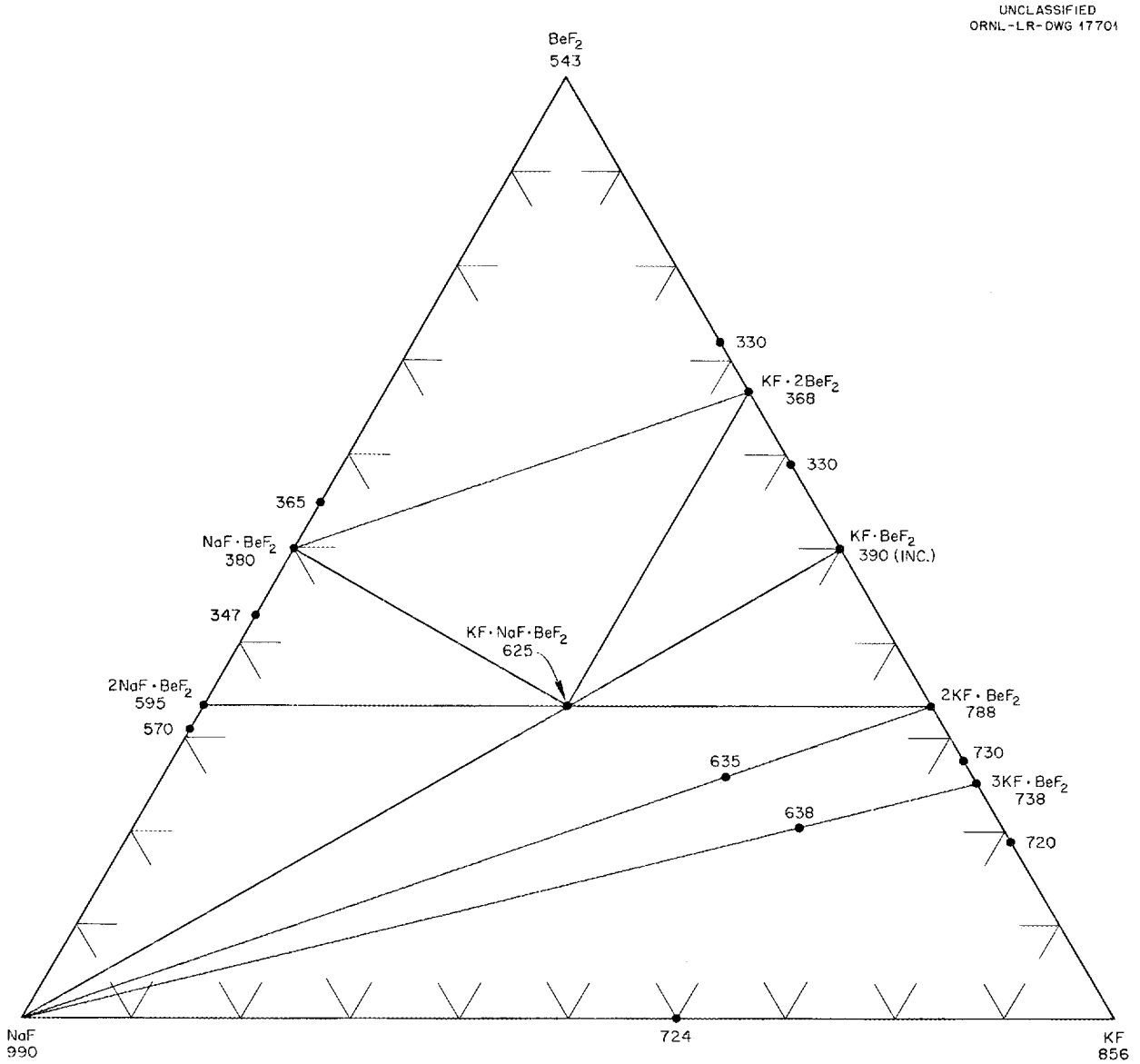
ORNL-LR-DWG. 1200



The System NaF–LiF–RbF.



Compatibility Triangles in the System NaF–KF–BeF_2.

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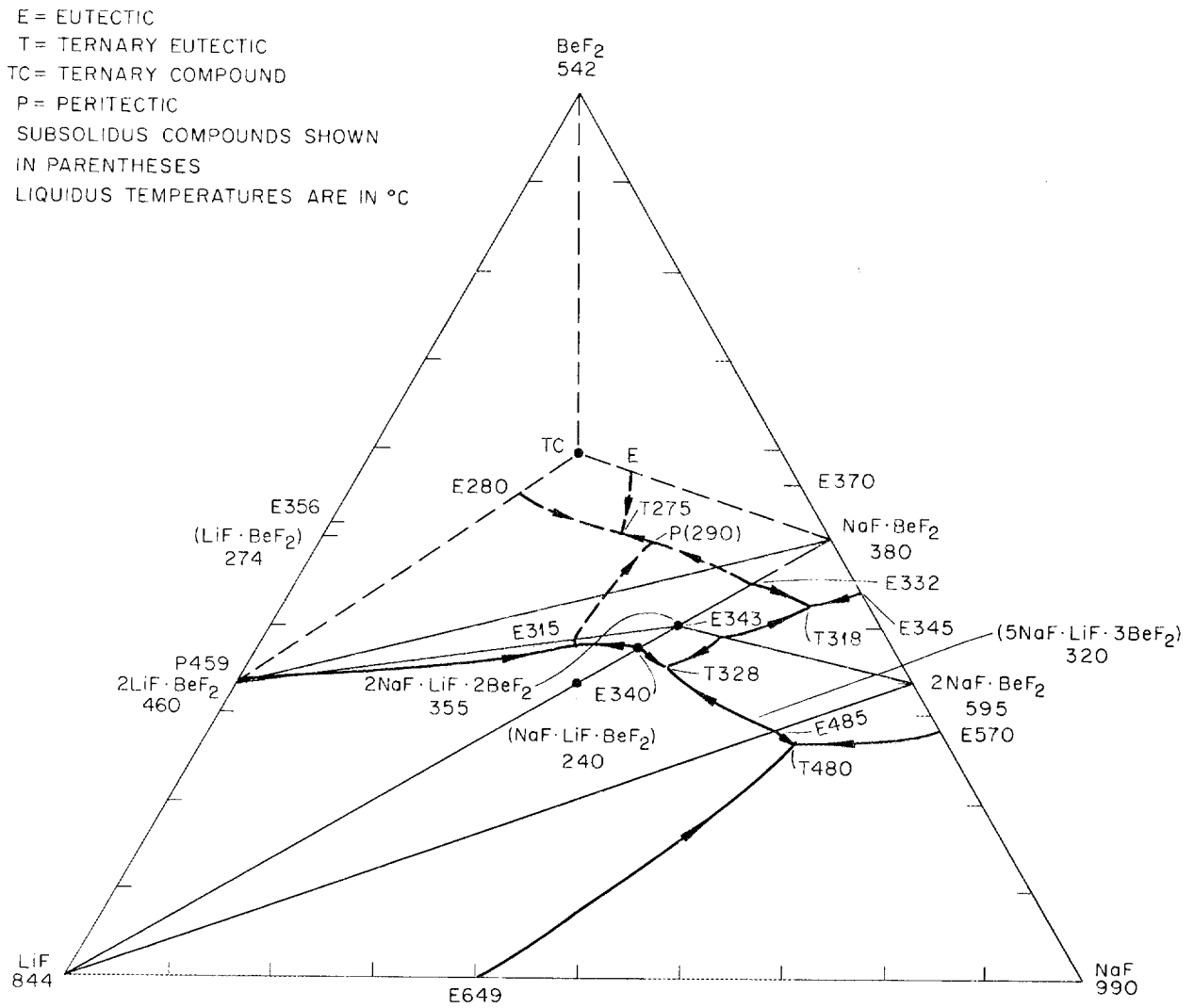
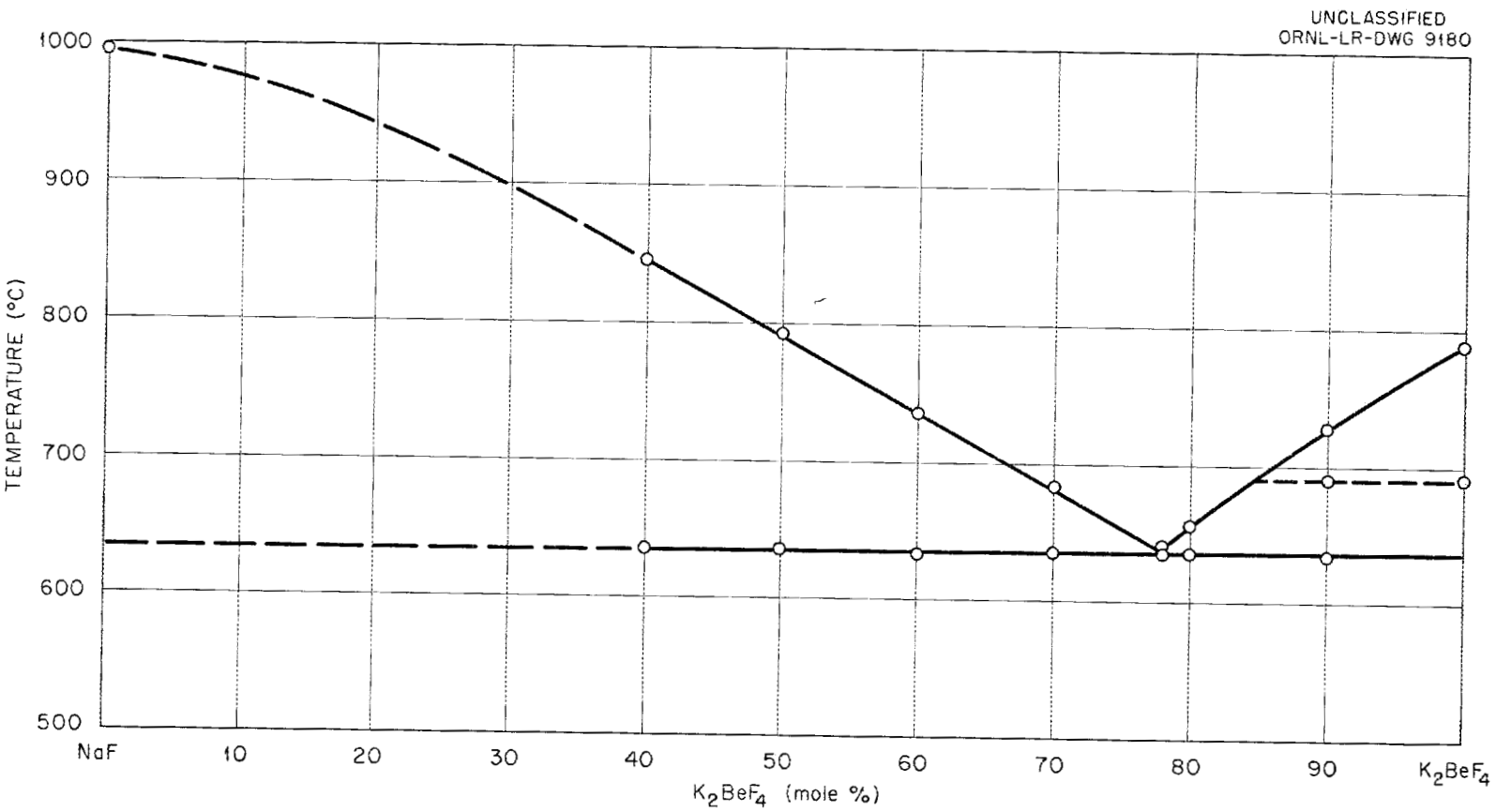
ORNL-LR-DWG 16151



The System LiF–NaF–BeF_2.



The Join NaF–K_2BeF_4.

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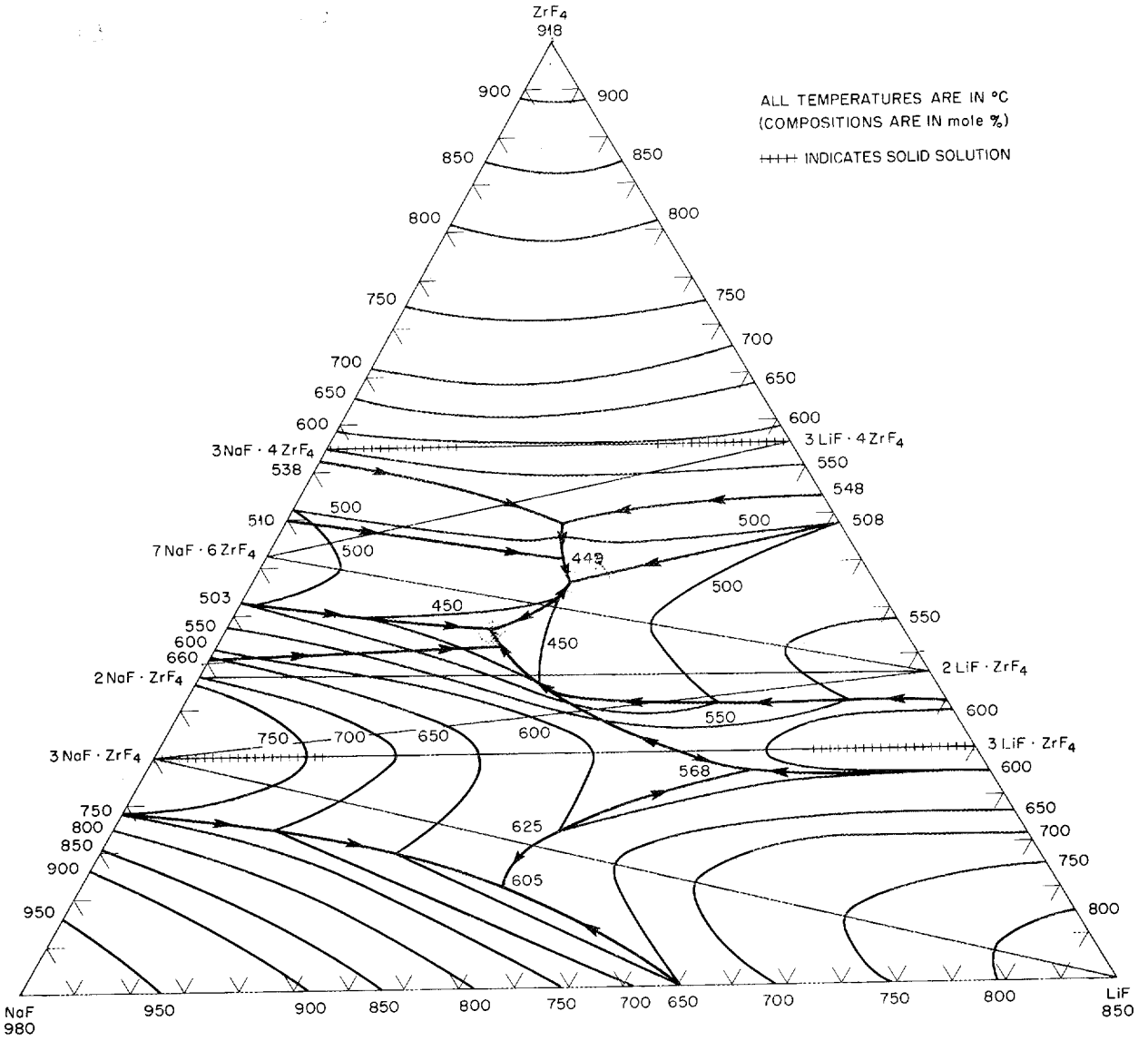
ORNL-LR-DWG 16959



The System NaF–LiF–ZrF_4.

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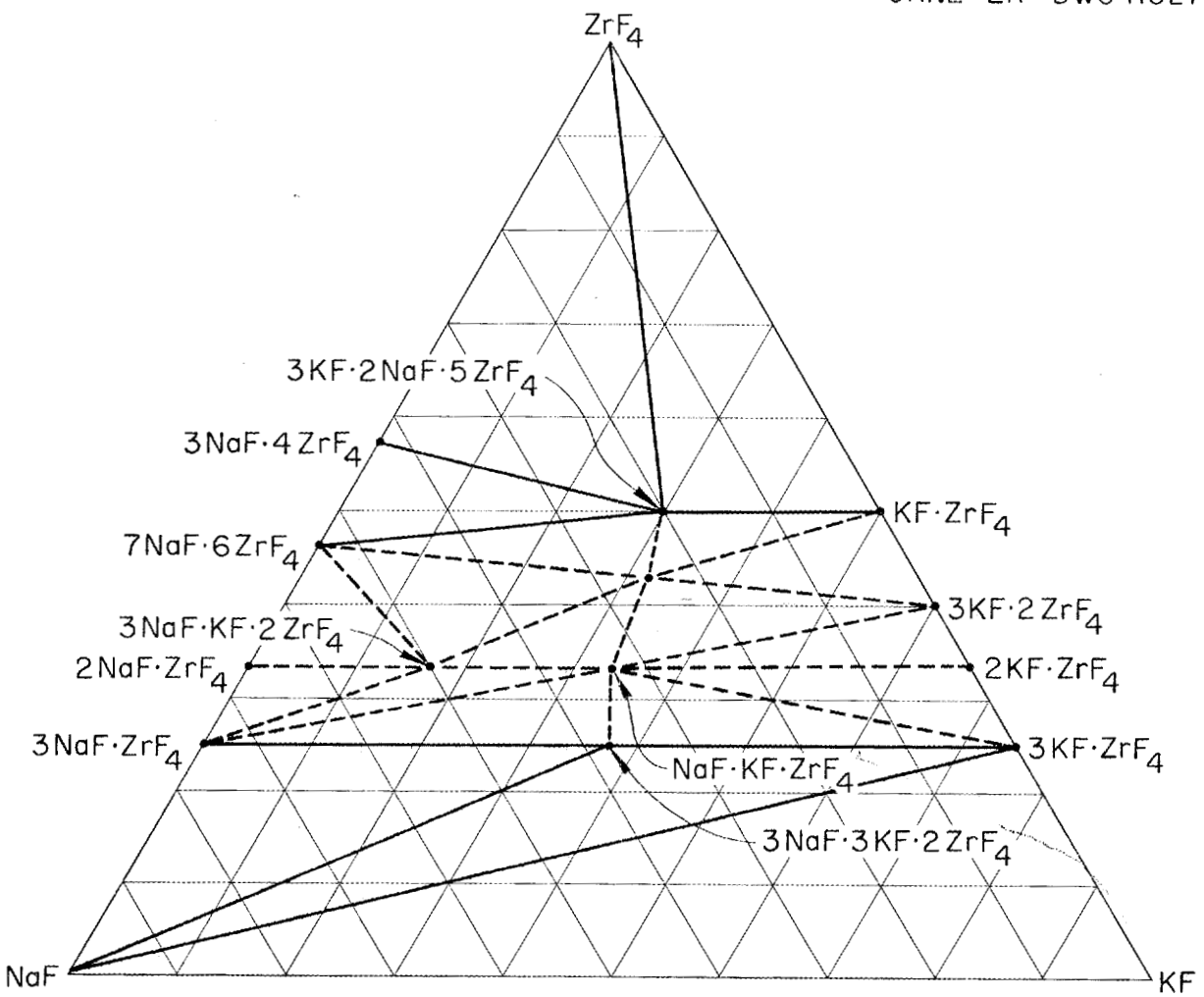
ORNL-LR-DWG 11527



Compatibility Triangles in the System $NaF-KF-ZrF_4$.

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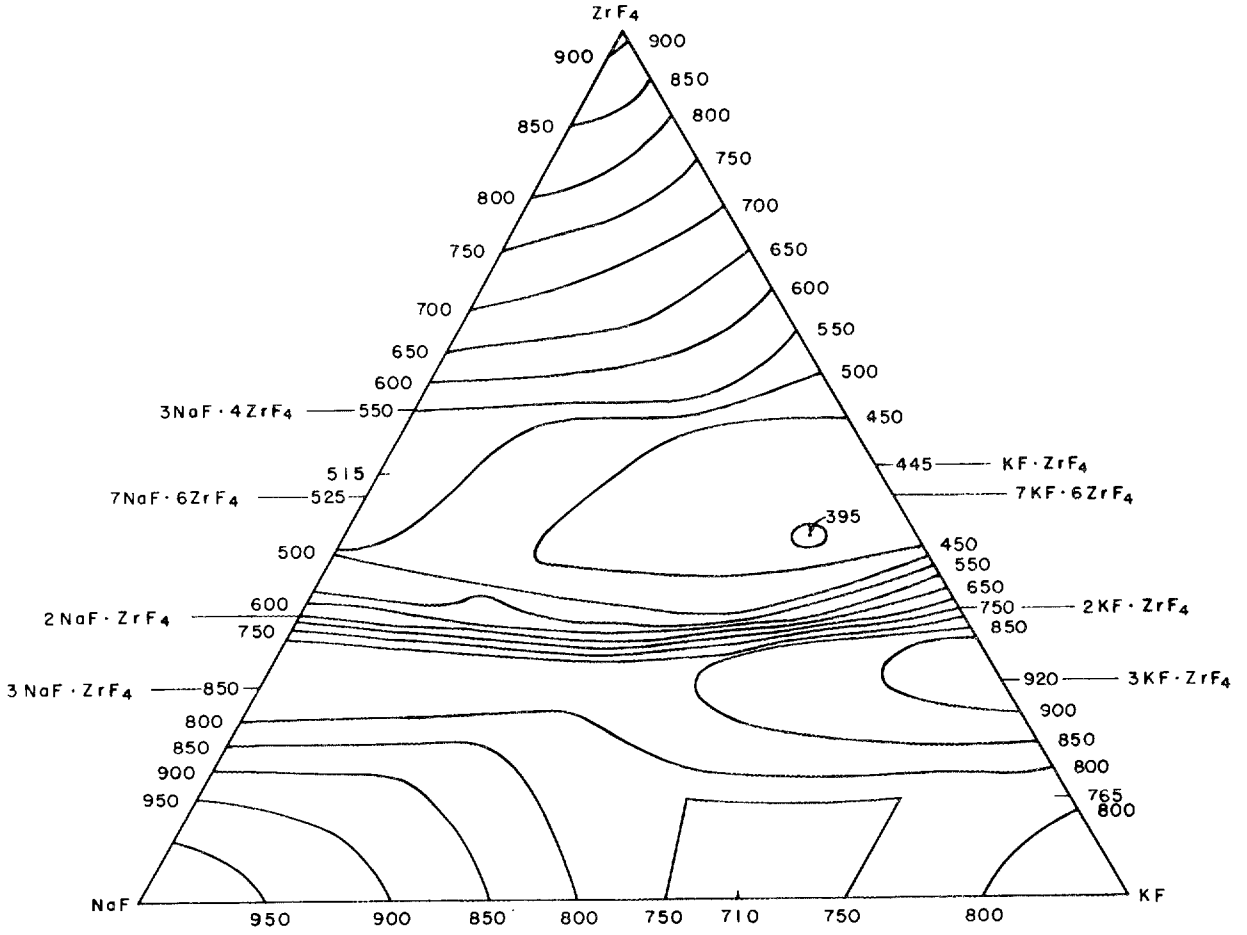
PHOTO 25043



Liquidus Temperature (°C) in the NaF–KF–ZrF_4 System.

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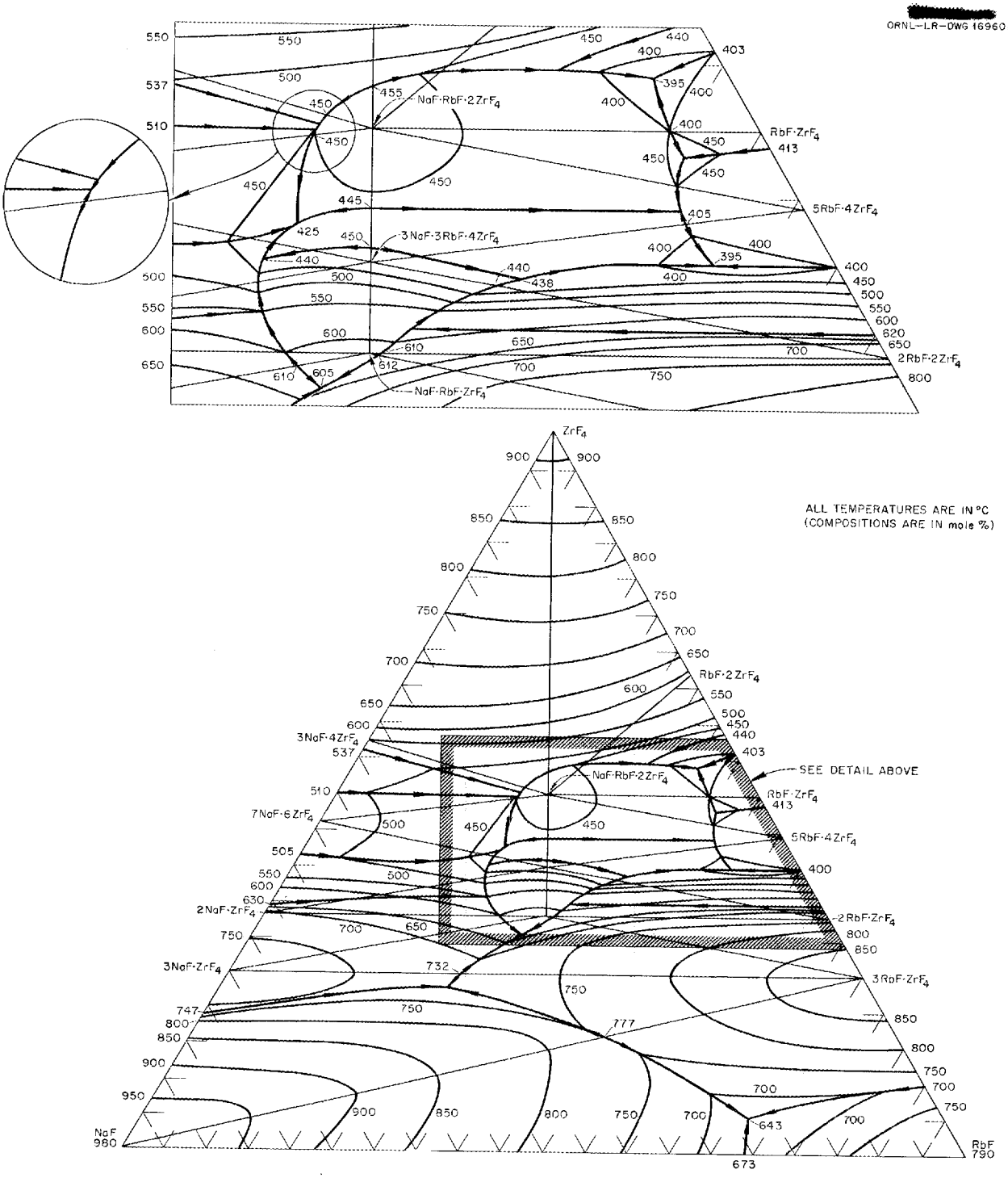
ORNL-LR-DWG 16960



The System NaF–RbF–ZrF_4.

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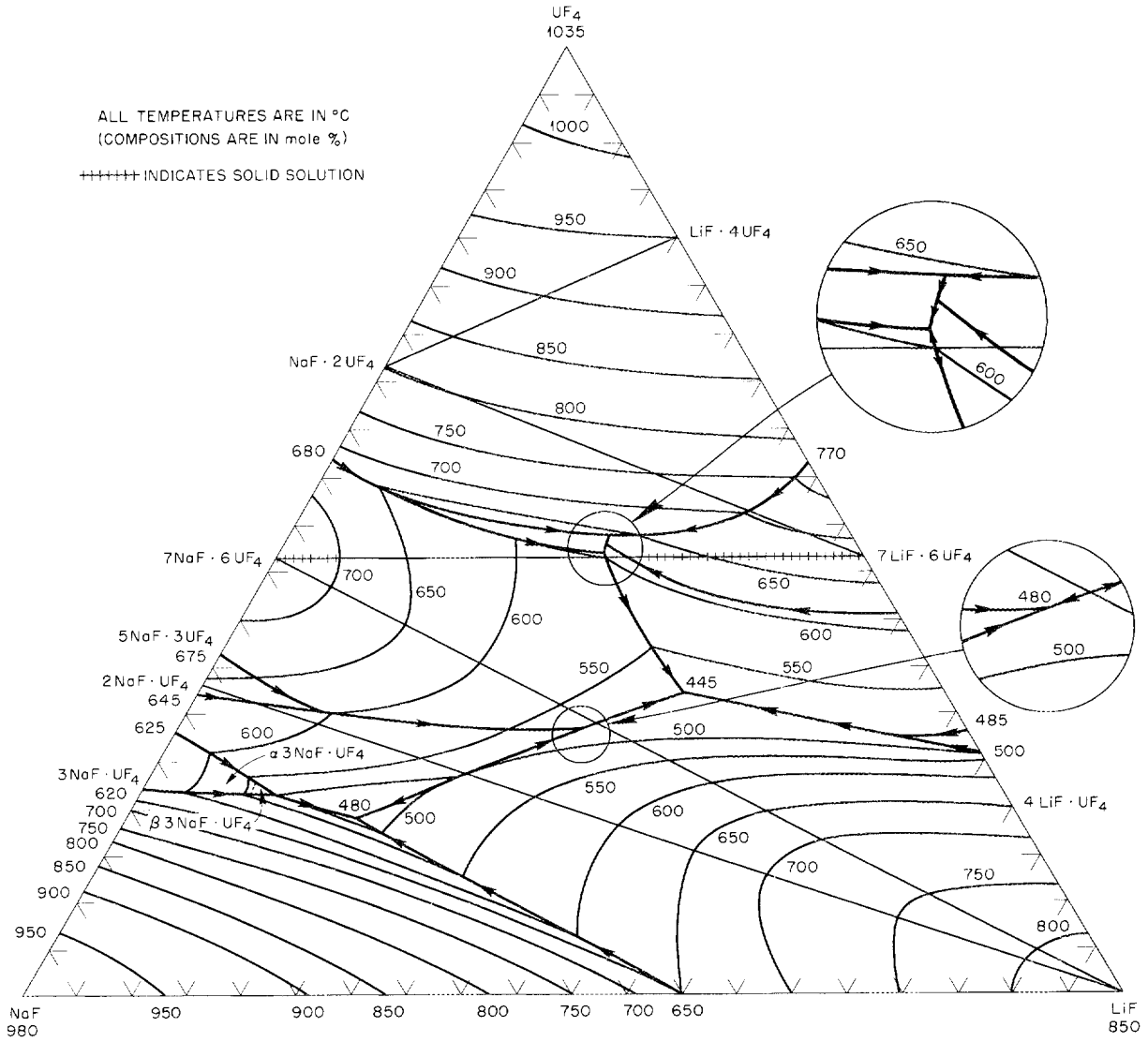
ORNL-LR-DWG 16958A



The System NaF–LiF–UF_4.

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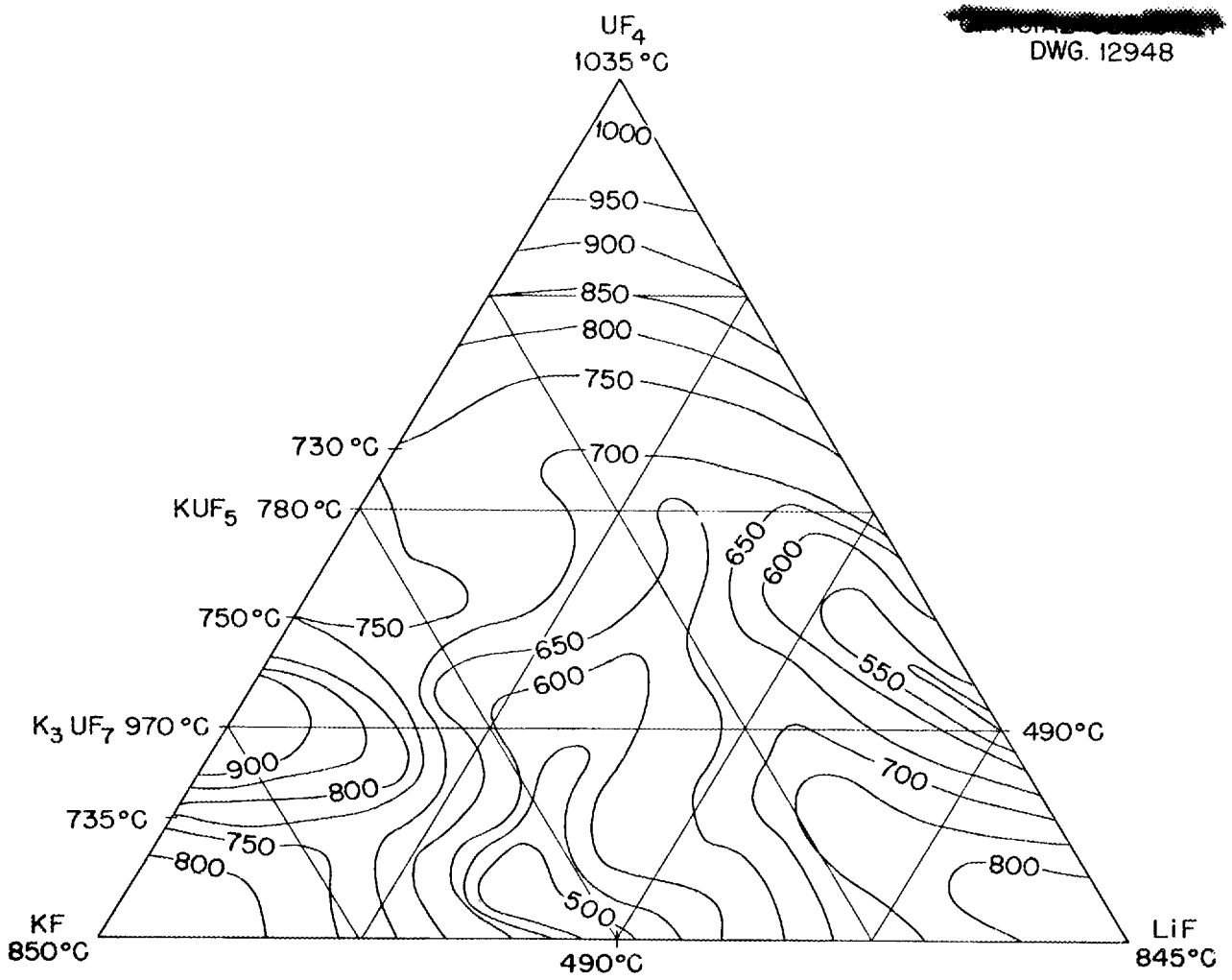
DWG. 12948



The System KF–LiF–UF_4.

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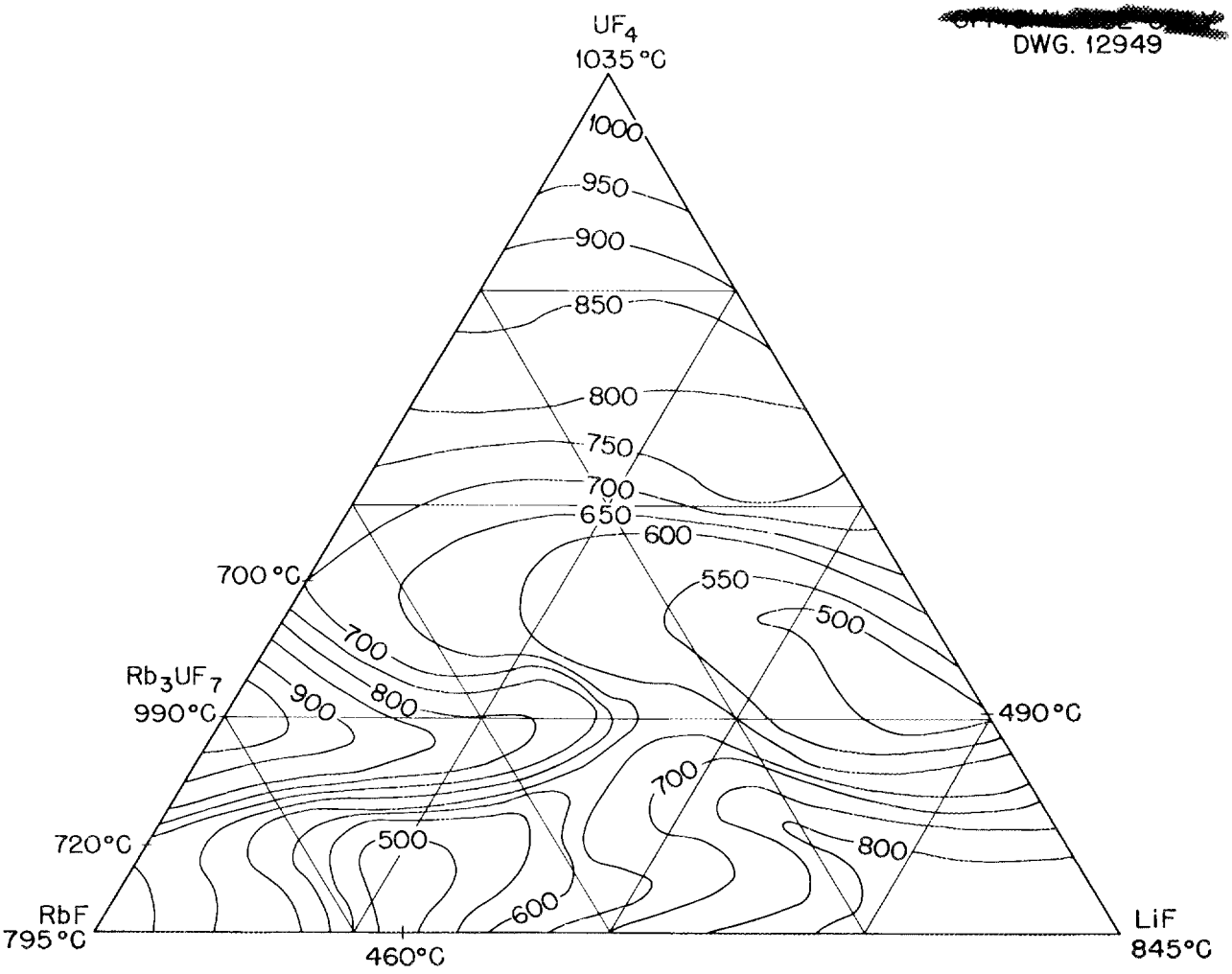
DWG. 12949



The System RbF–LiF–UF_4.

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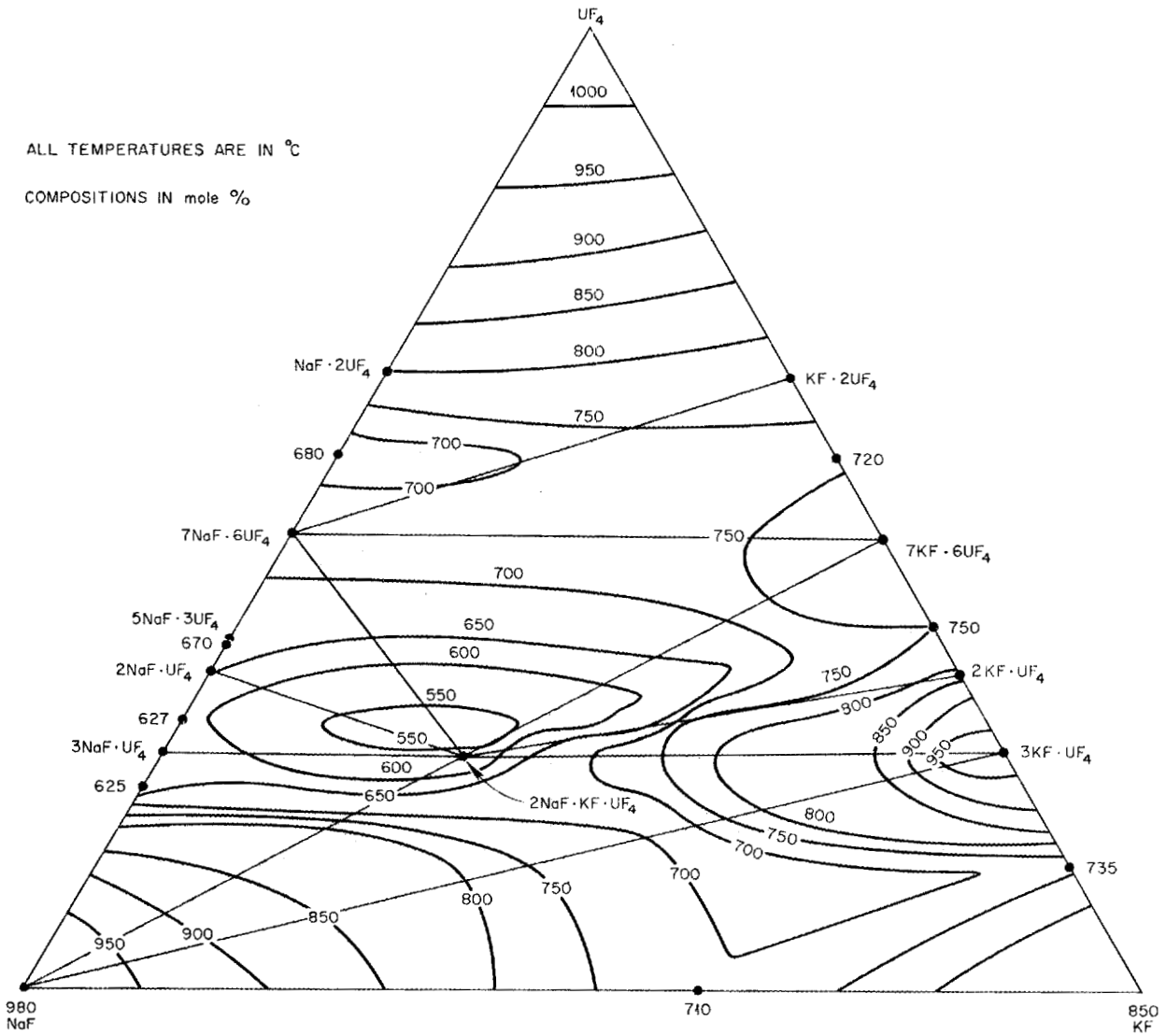
ORNL-LR-DWG 16950



The System NaF–KF–UF_4; Liquidus Temperatures and Compatibility Triangles.

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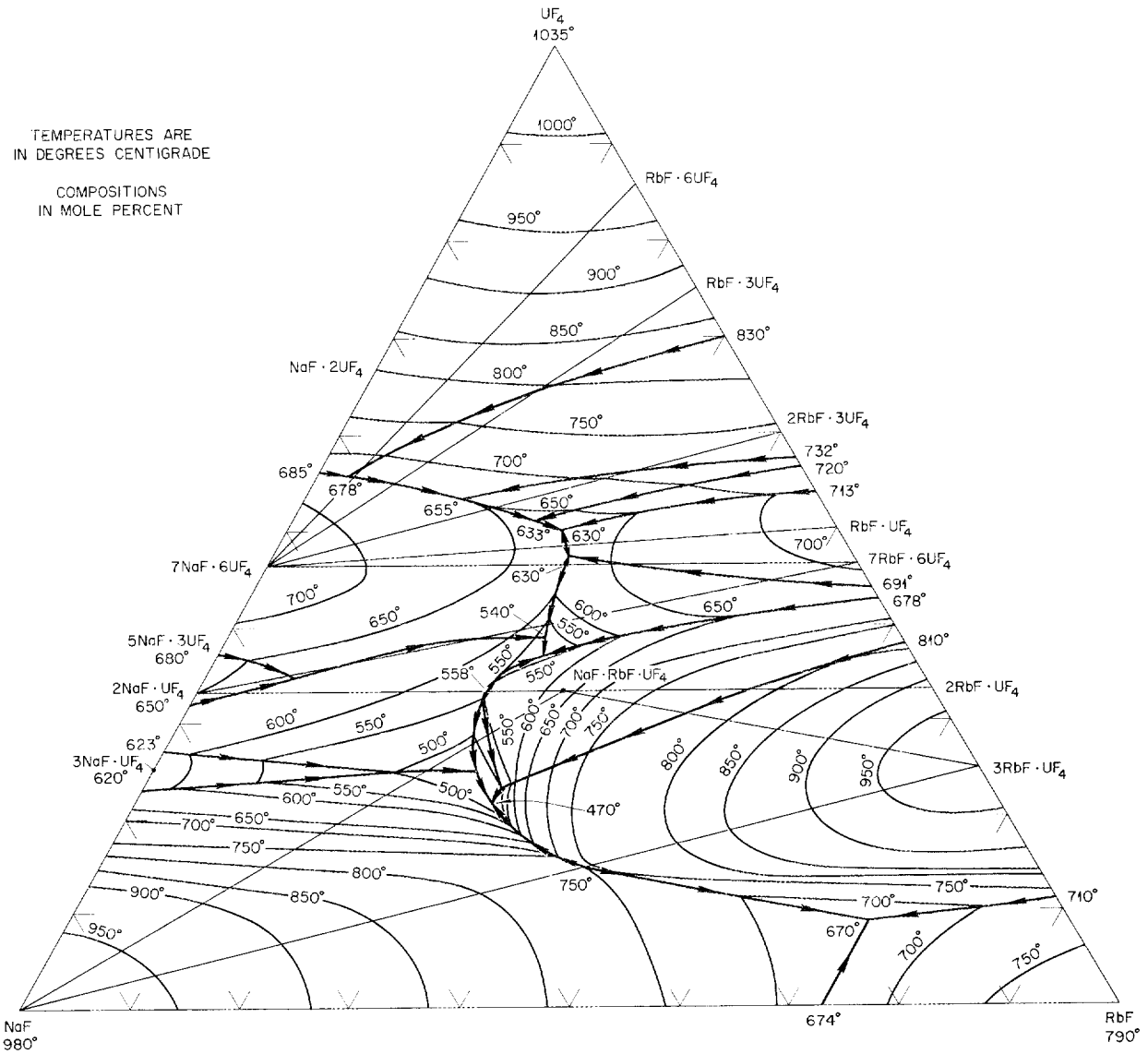
ORNL-LR-DWG 16741A



The System NaF–RbF–UF_4.

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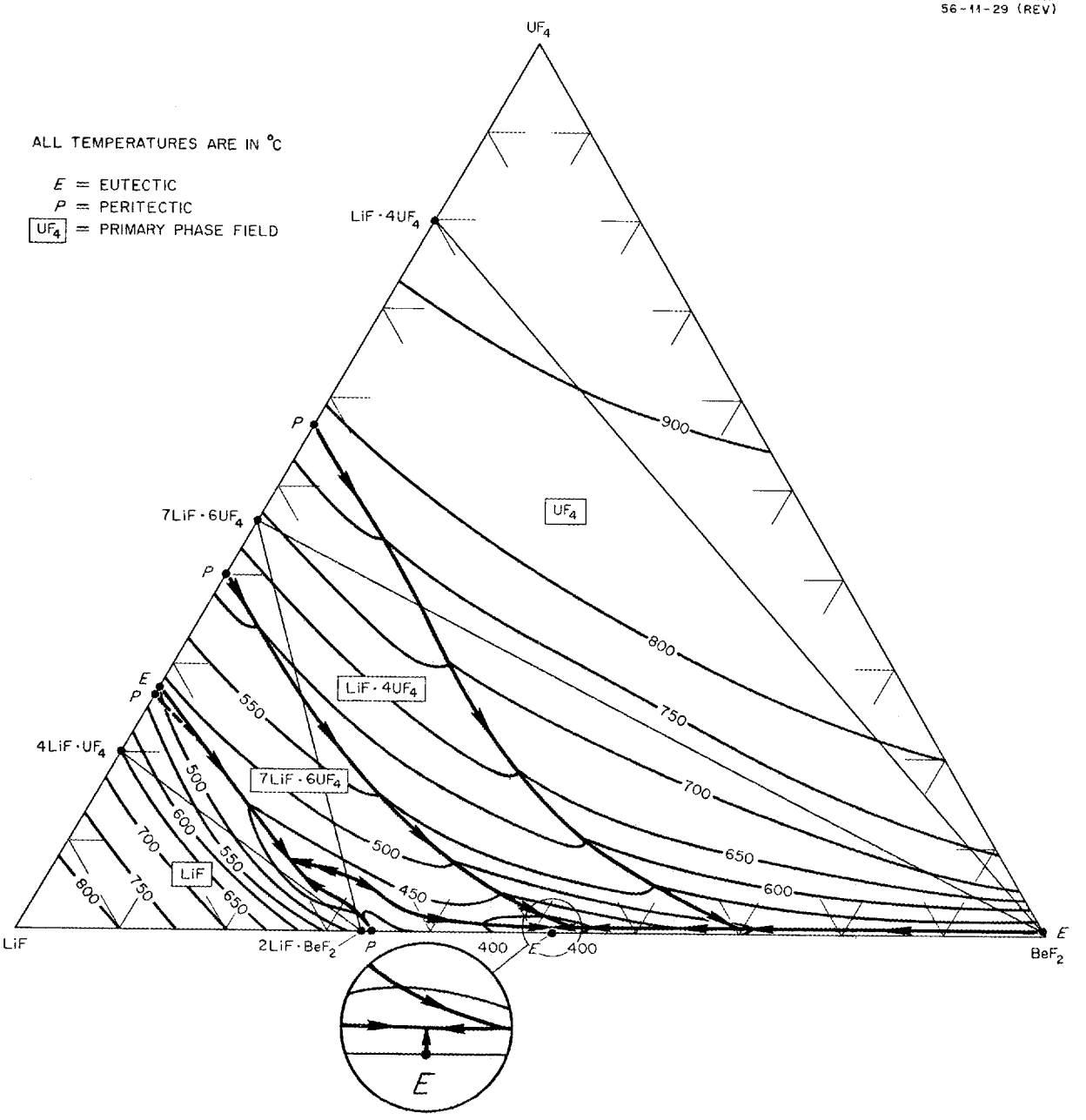
MOUND LAB. NO.
56-11-29 (REV)



The System $LiF-BeF_2-UF_4$.

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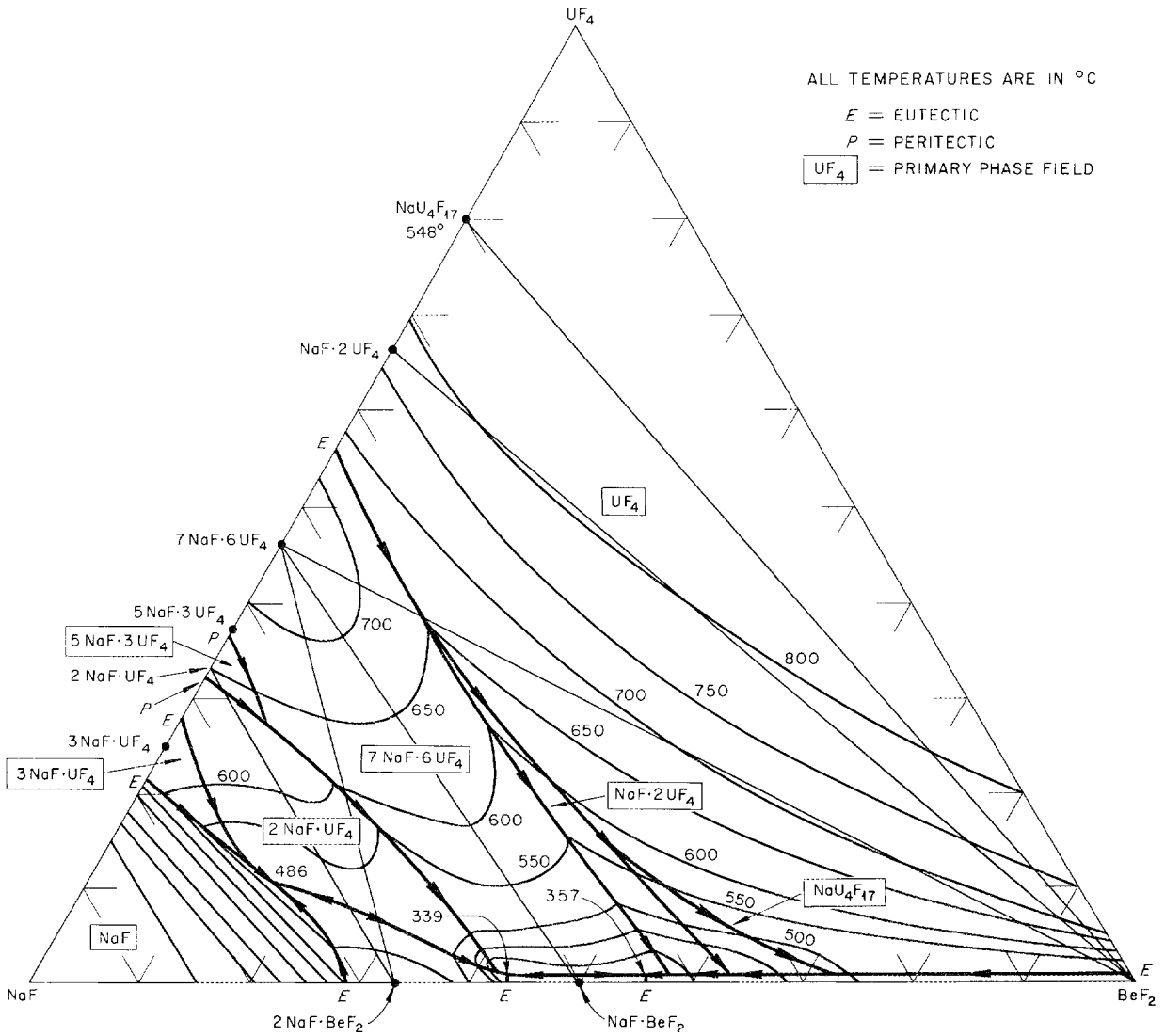

The System $NaF-BeF_2-UF_4$.

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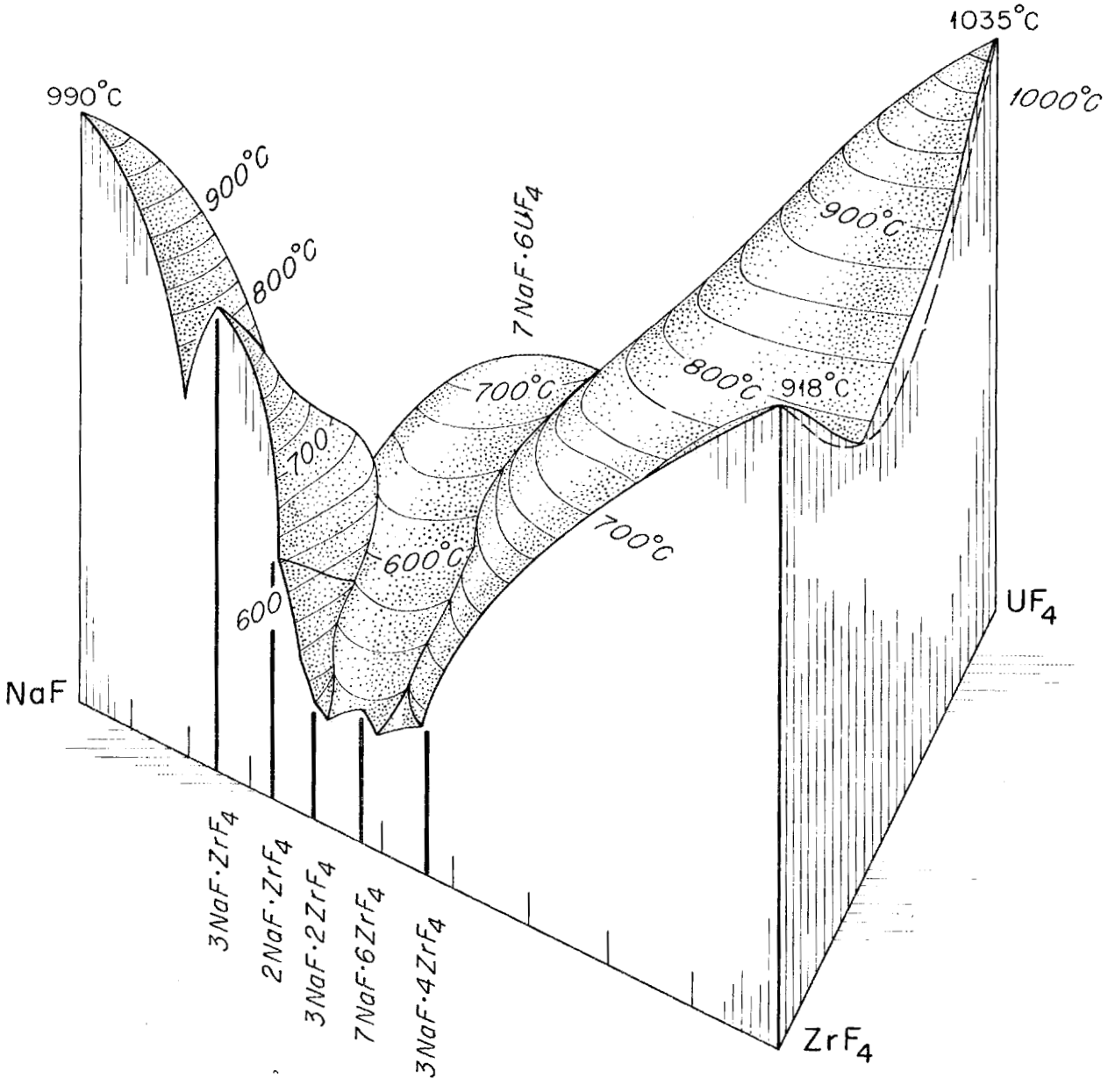
ORNL-LR-DWG 3398



The System $NaF-ZrF_4-UF_4$.

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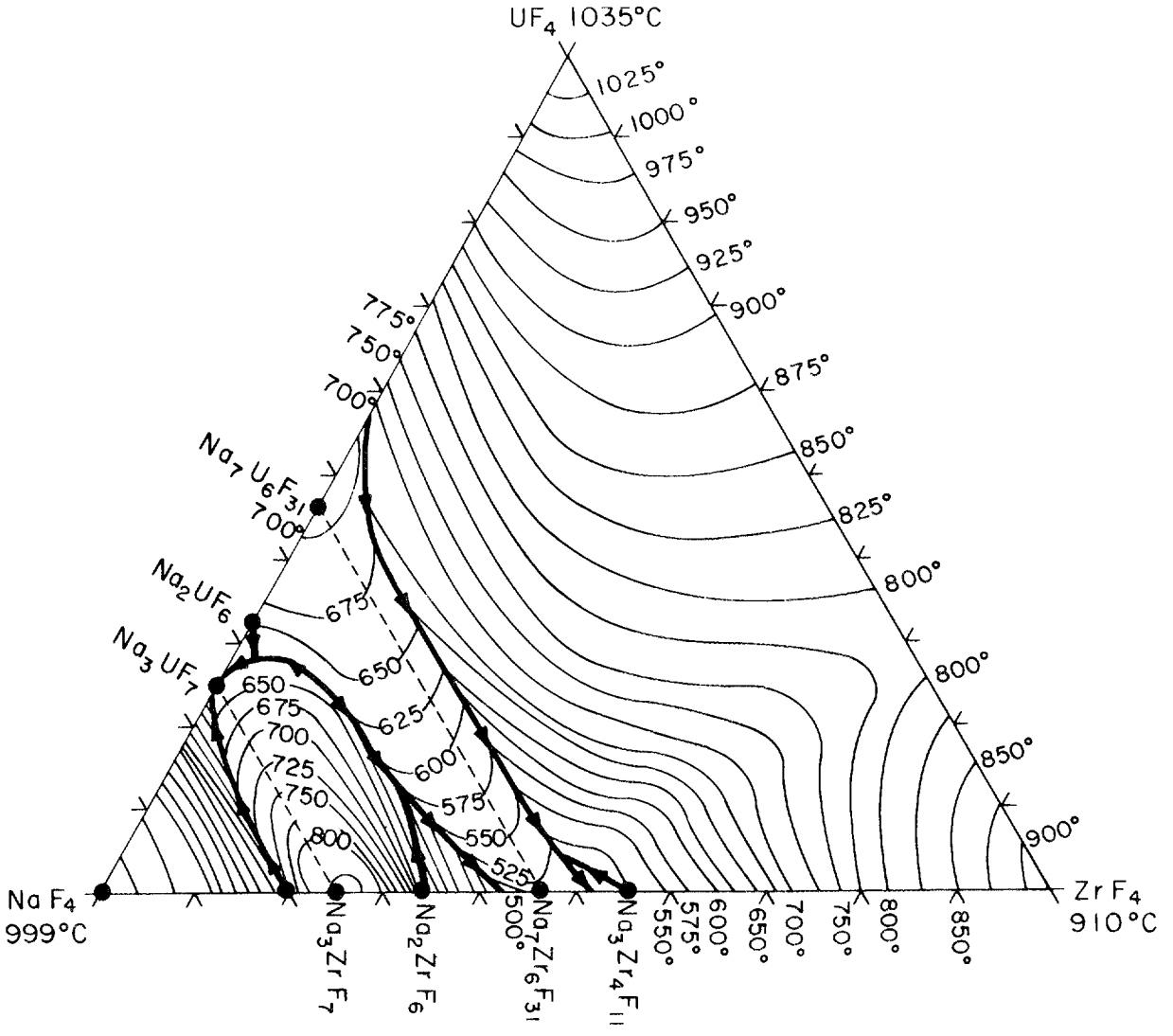
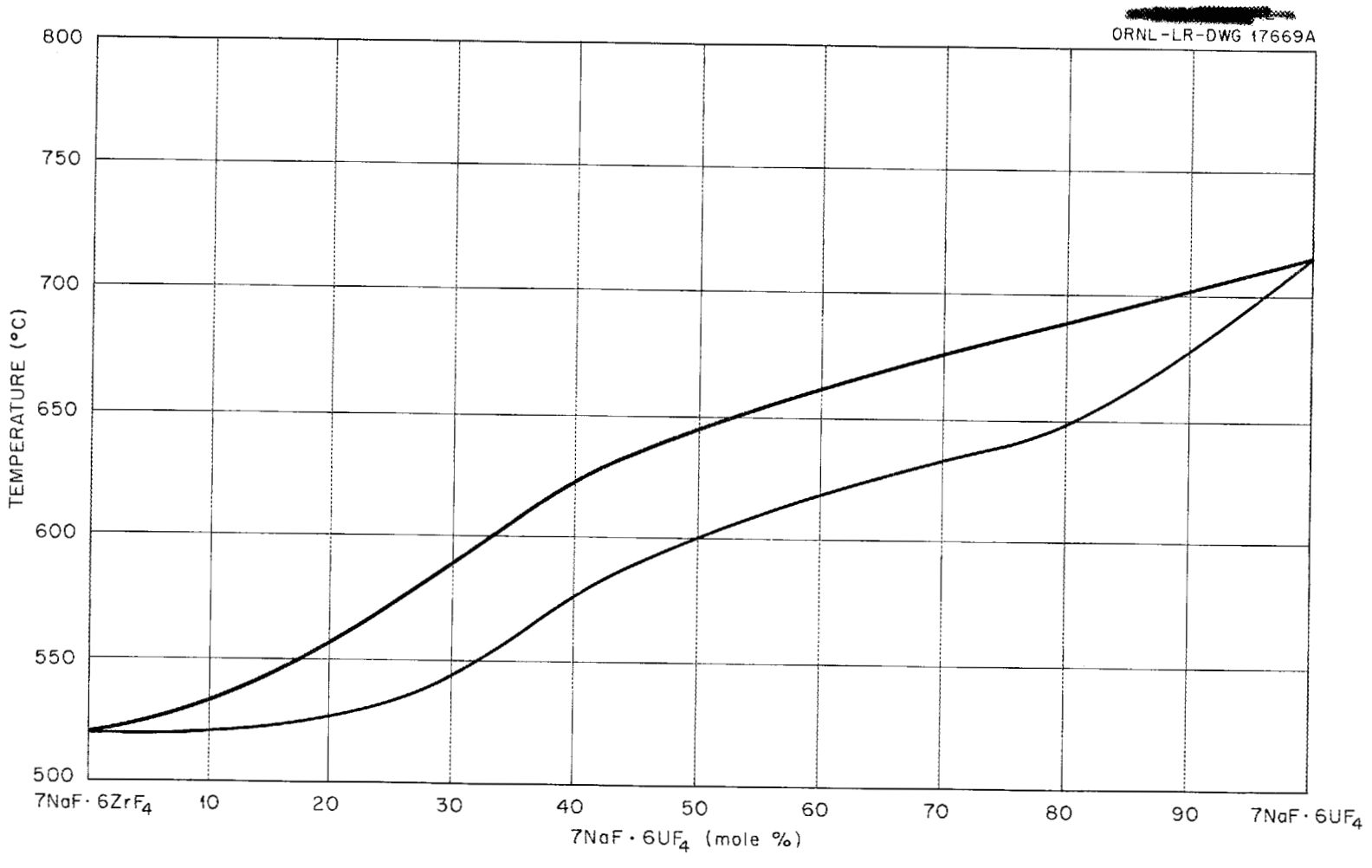
PHOTO 22349



Liquidus Temperatures in the System $NaF-ZrF_4-UF_4$.



The System $7NaF \cdot 6ZrF_4$–$7NaF \cdot 6UF_4$.

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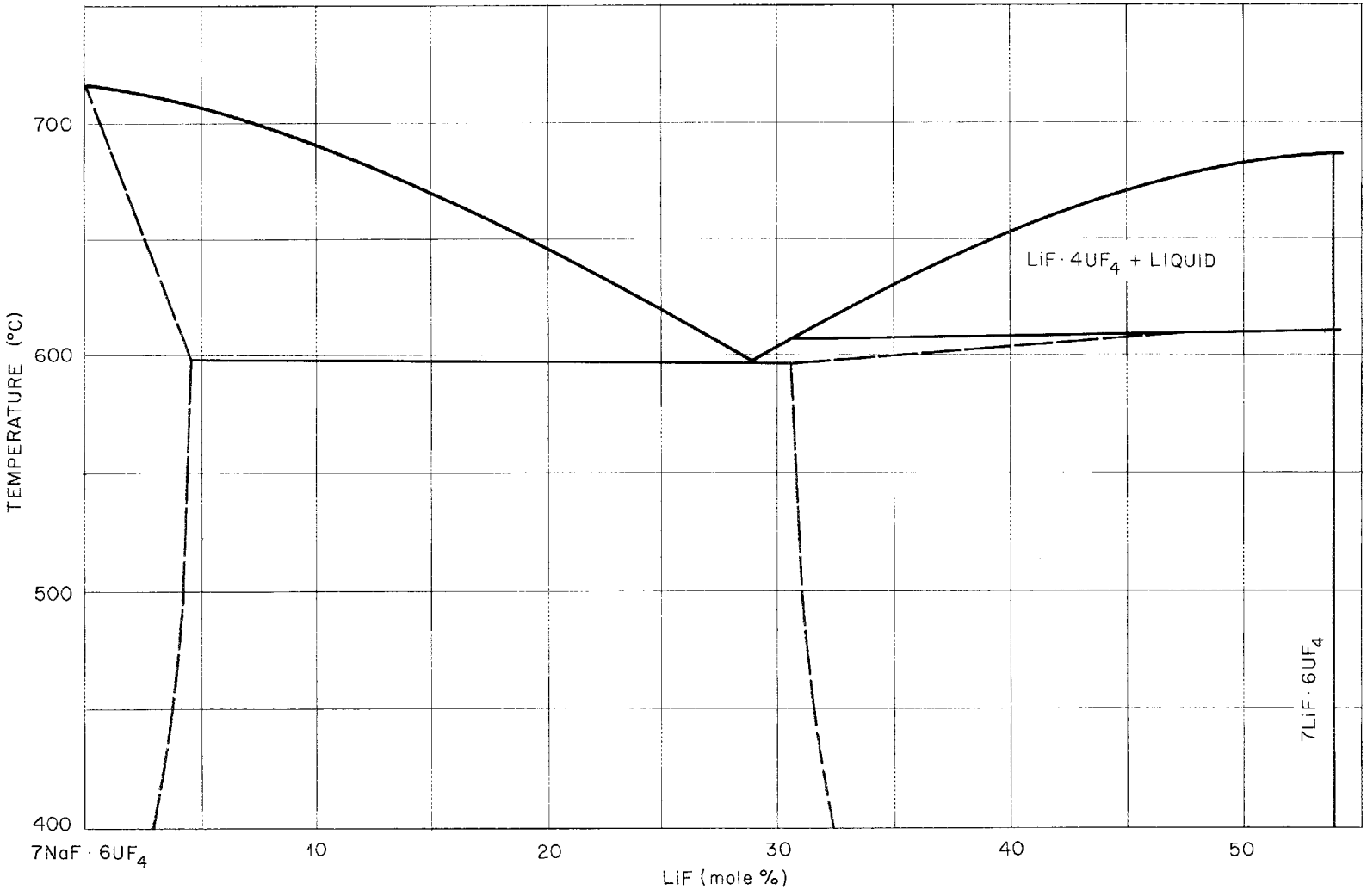
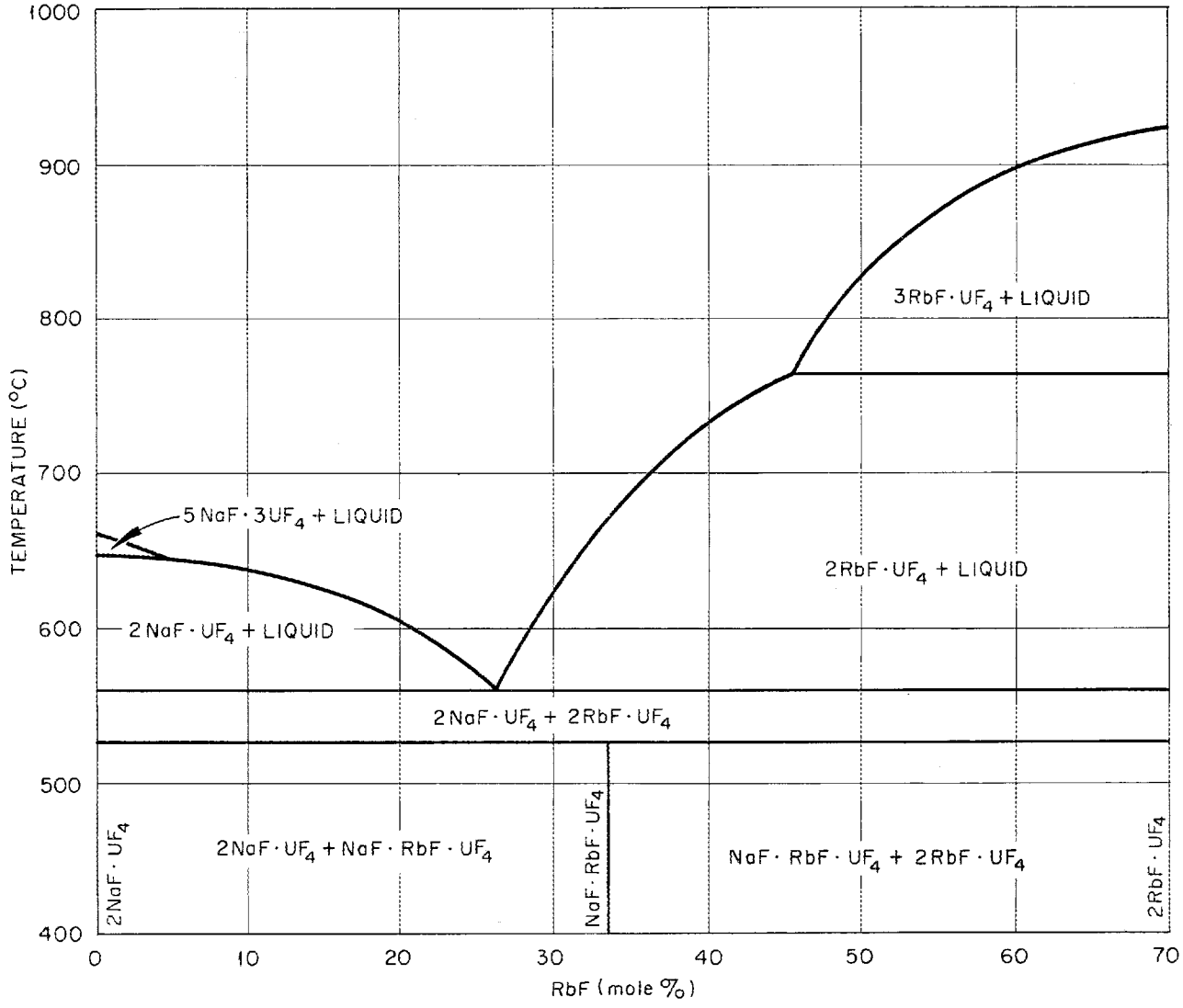
ORNL-LR-DWG 18747



The Join $7NaF \cdot 6UF_4$–$7LiF \cdot 6UF_4$.

[redacted]

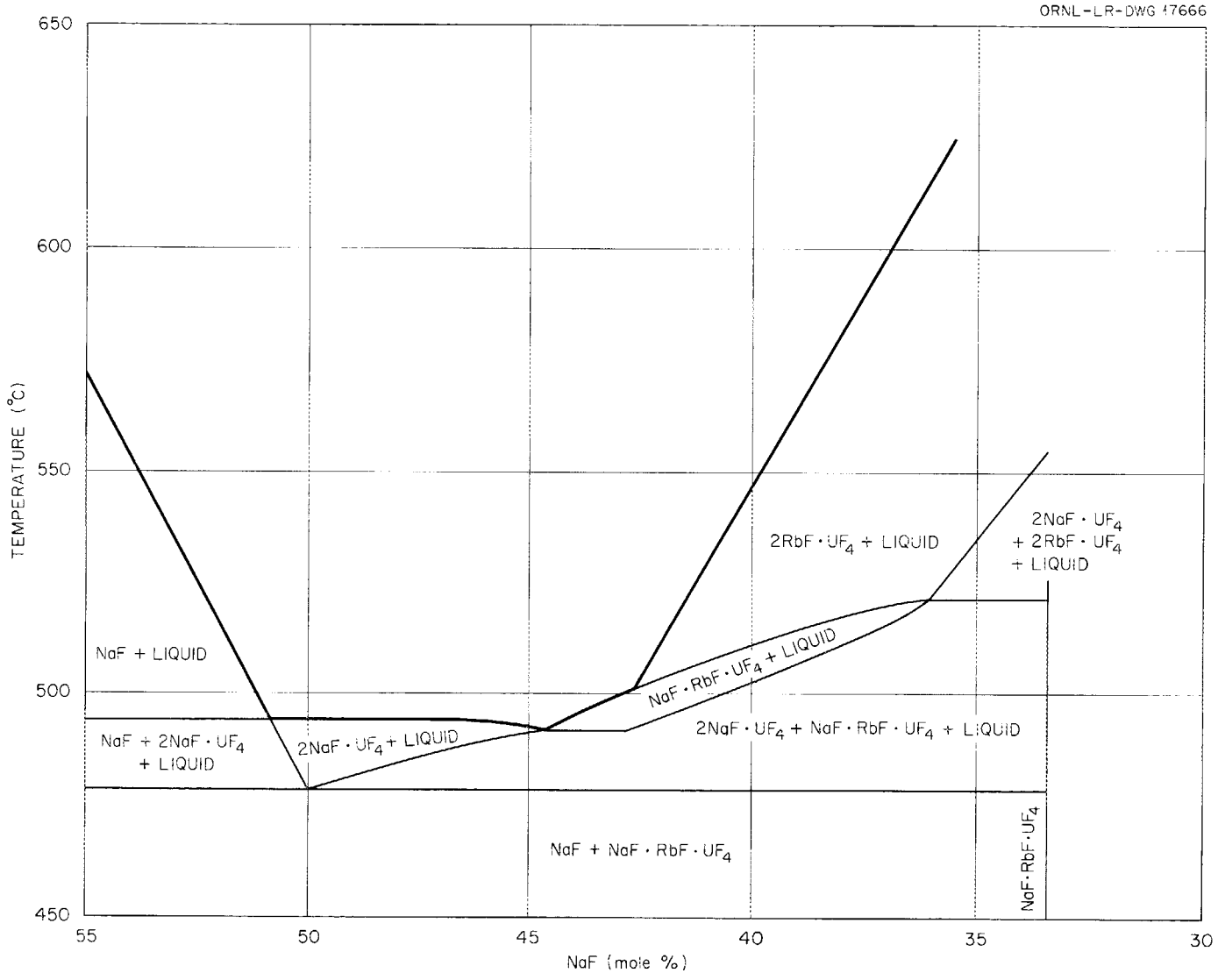
ORNL-LR-DWG 17665

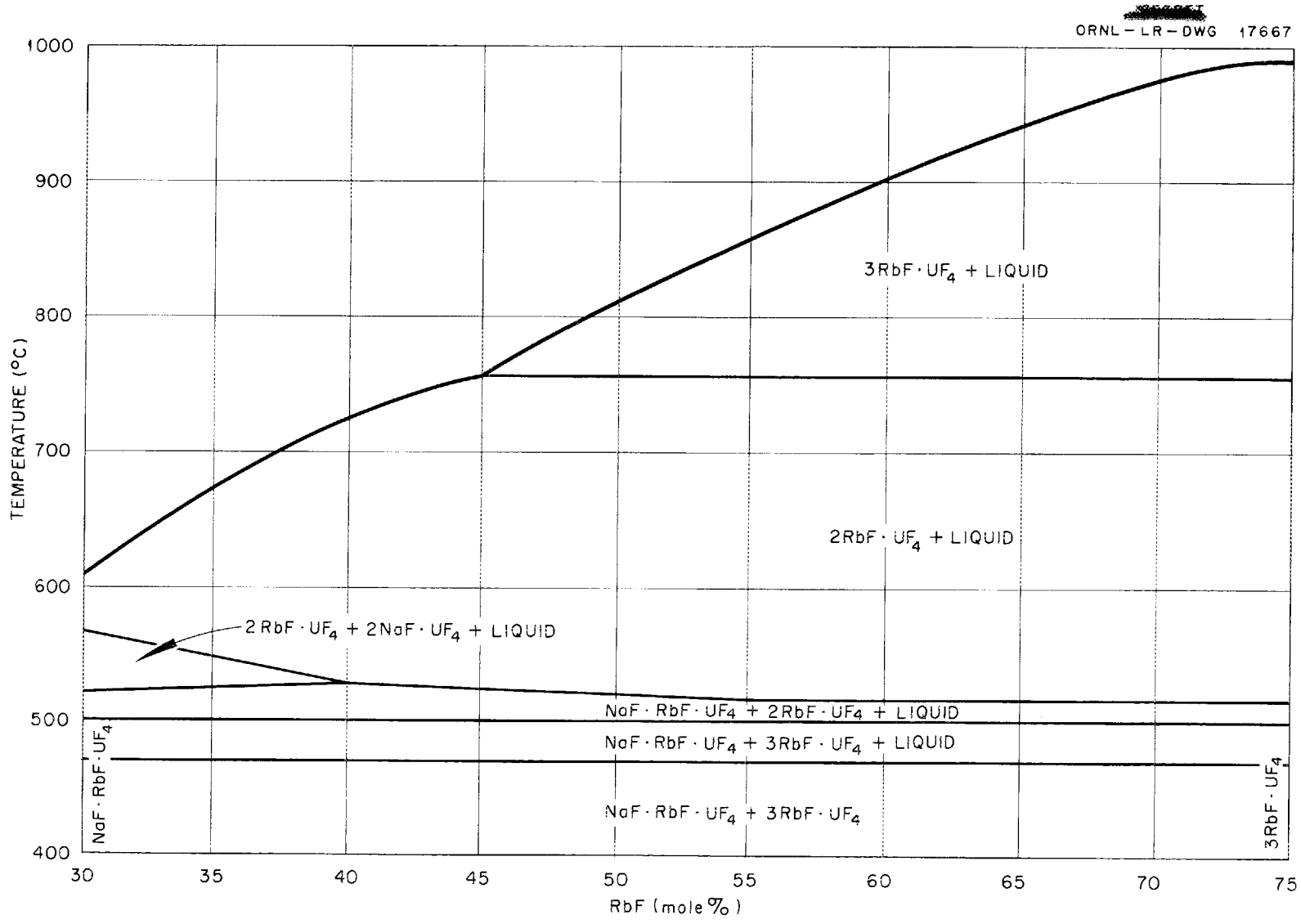


The Join $2NaF \cdot UF_4$–$2RbF \cdot UF_4$.

[redacted]

ORNL-LR-DWG 17666

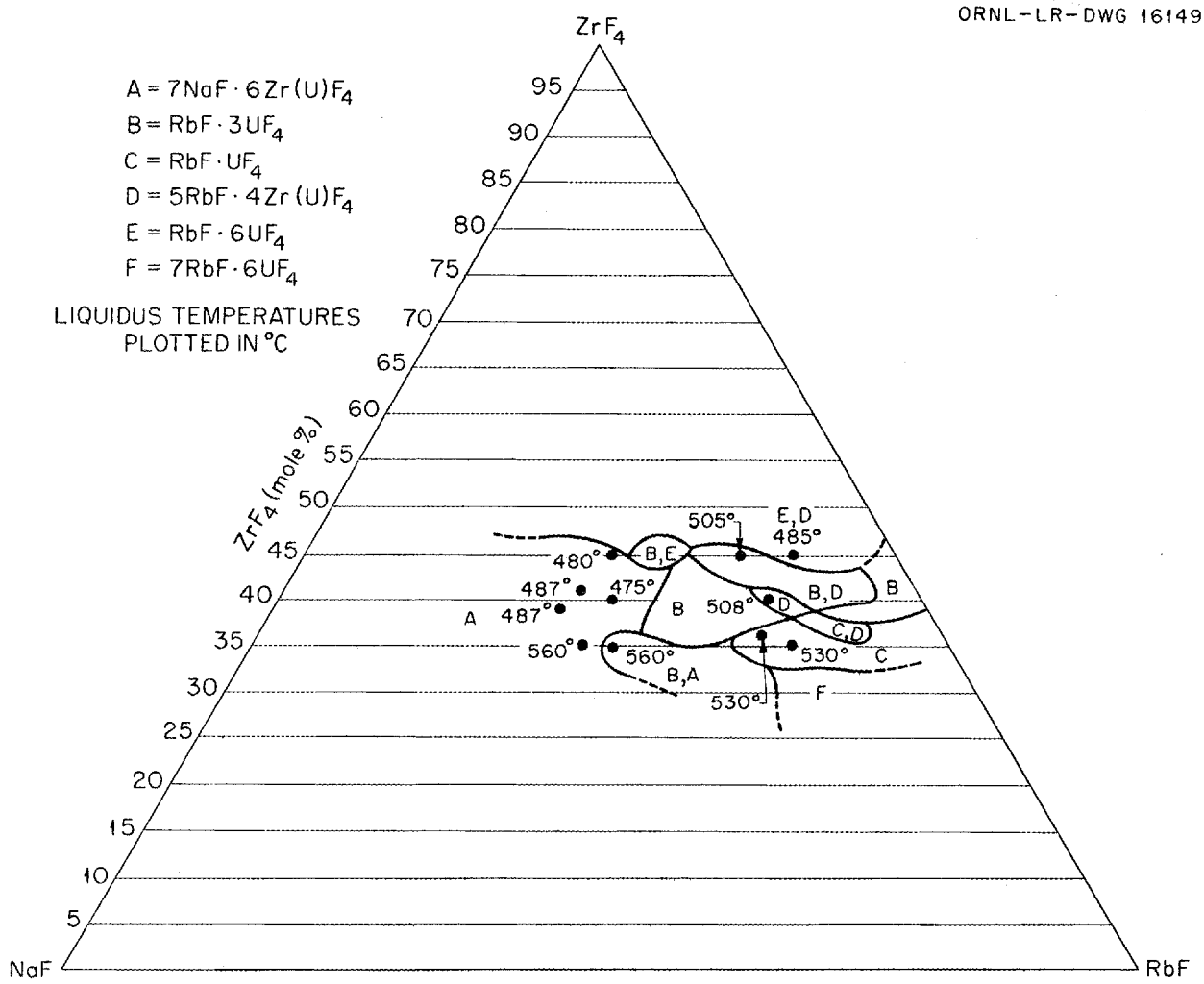




The Join $NaF \cdot RbF \cdot UF_4$–$3RbF \cdot UF_4$.

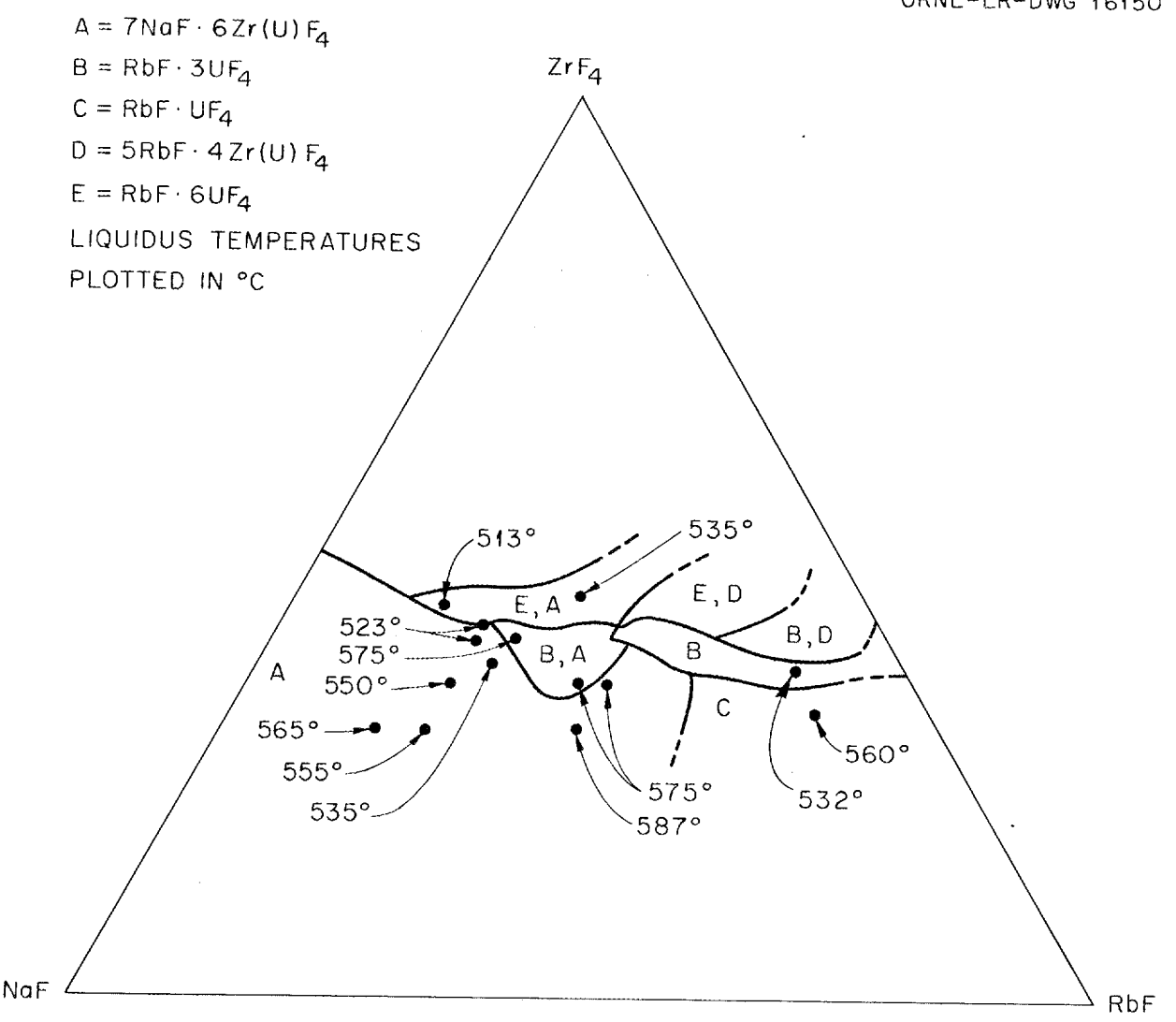
[redacted]

ORNL-LR-DWG 16149

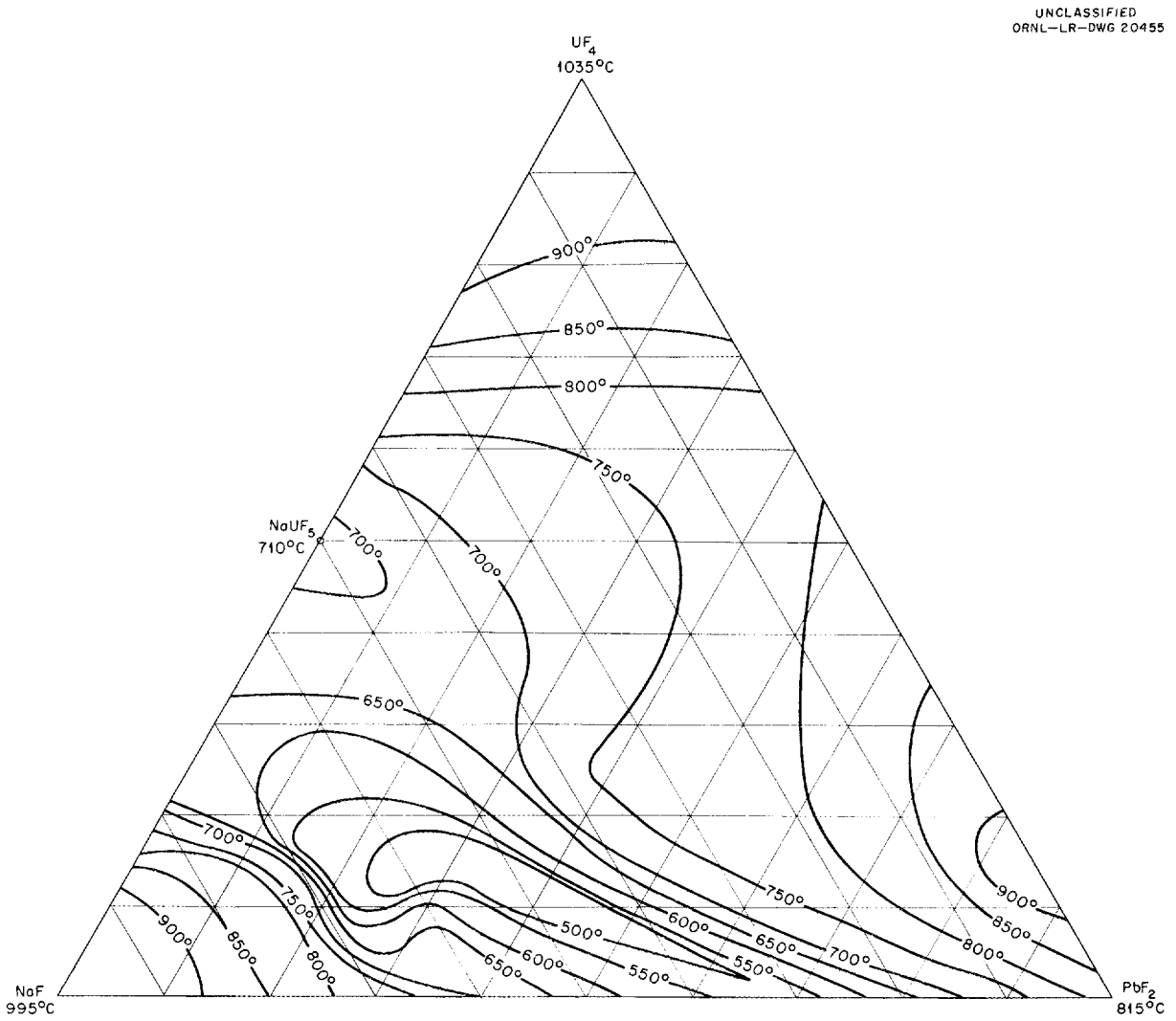


Primary and Secondary Uranium-Containing Phases in the System NaF–RbF–ZrF_4–UF_4 with 4 Mole % UF_4.

[redacted] ORNL-LR-DWG 16150



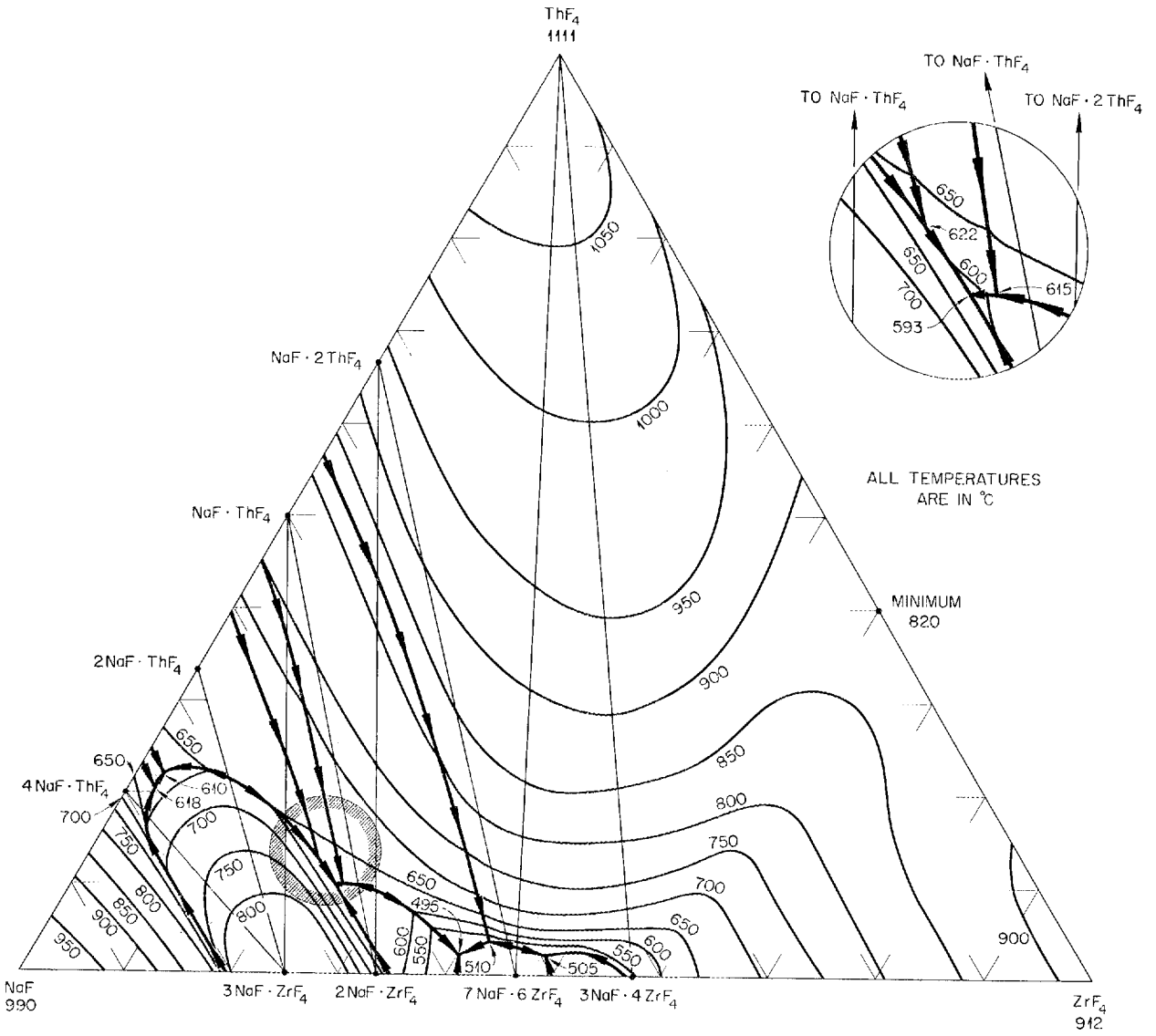
Primary and Secondary Uranium-Containing Phases in the System NaF–RbF–ZrF_4–UF_4 with 7 Mole % UF_4.



The System $NaF-PbF_2-UF_4$.

[redacted]

ORNL-LR-DWG 20466



The System $NaF-ZrF_4-ThF_4$.

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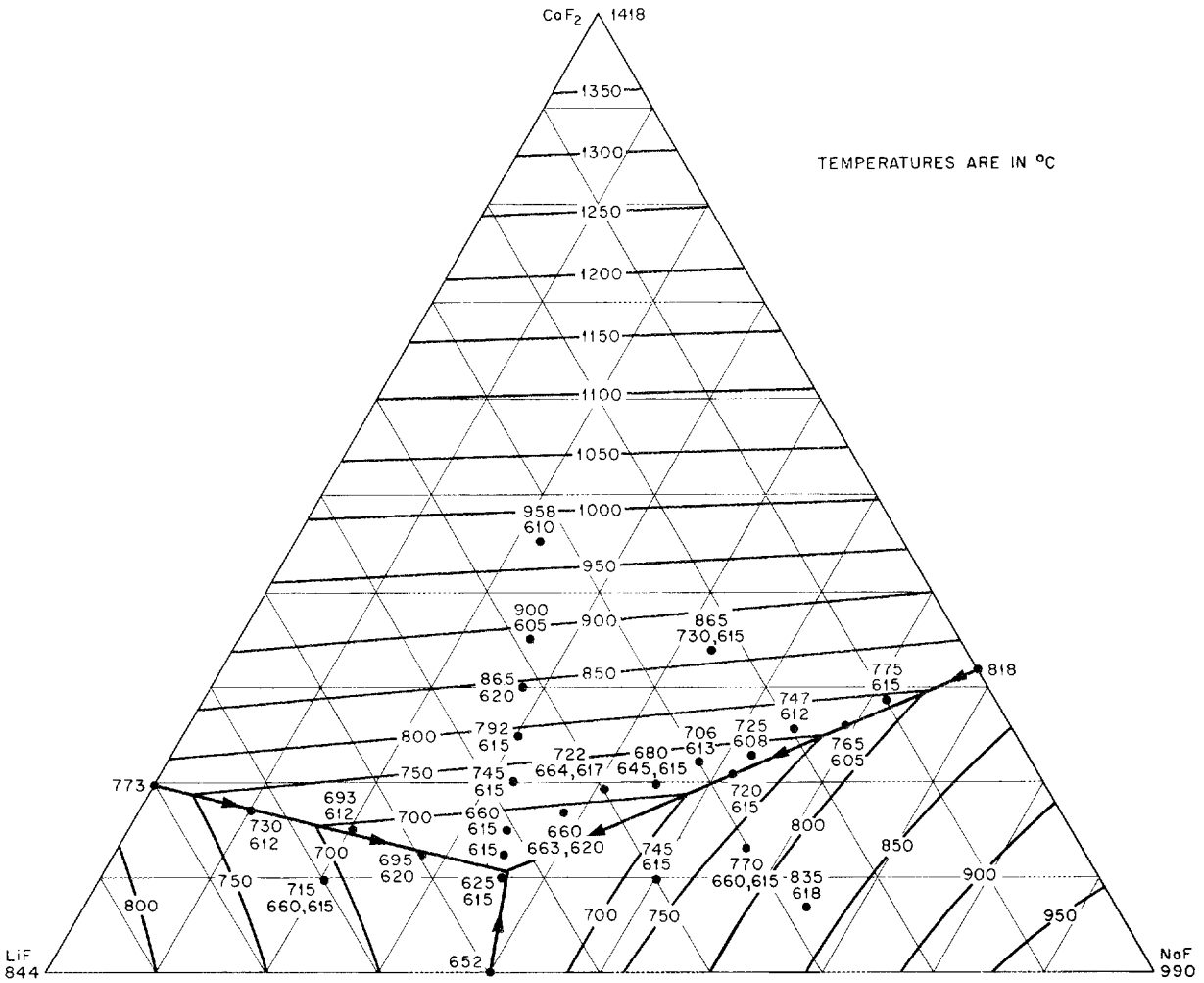
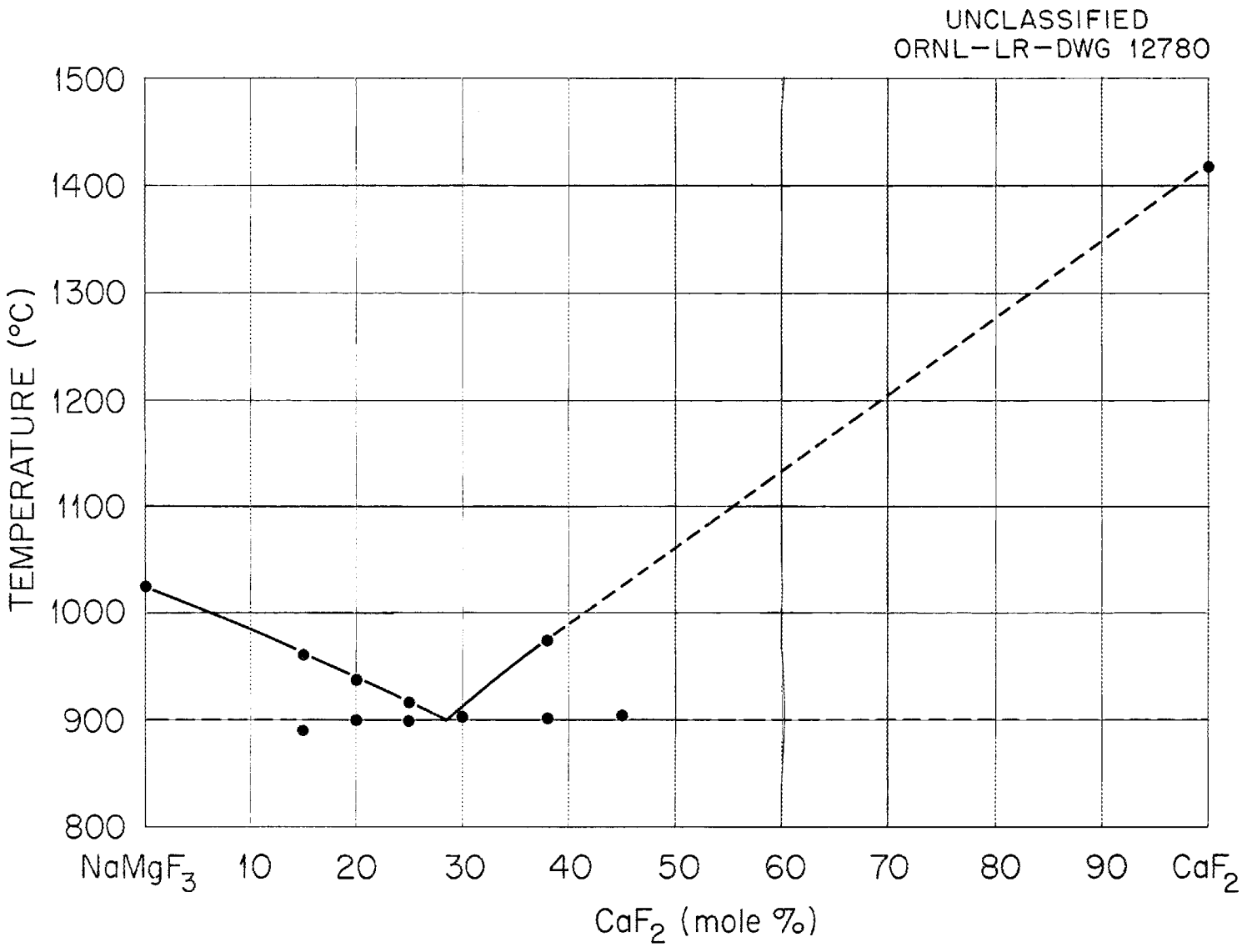
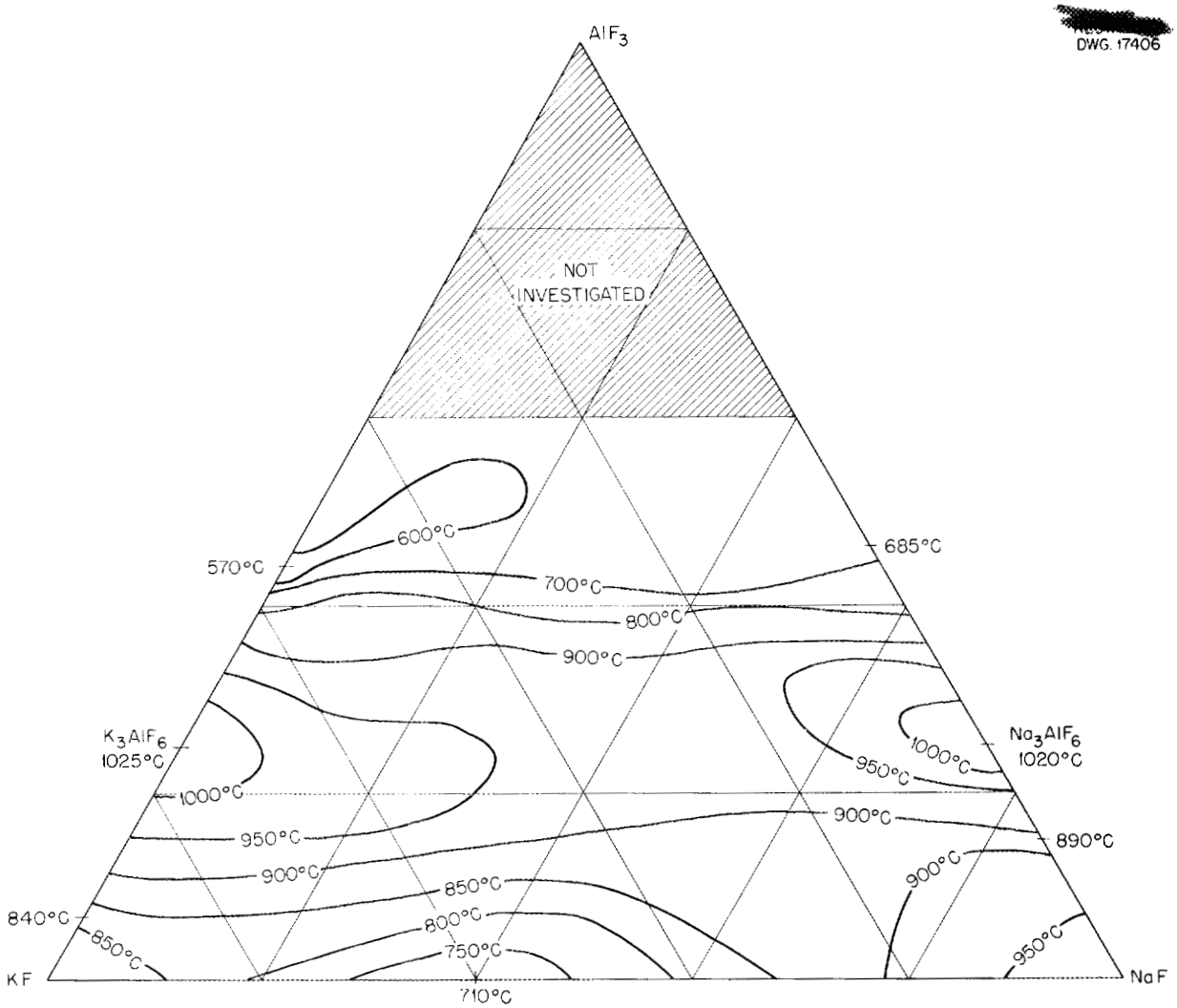


The System LiF–NaF–CaF_2.



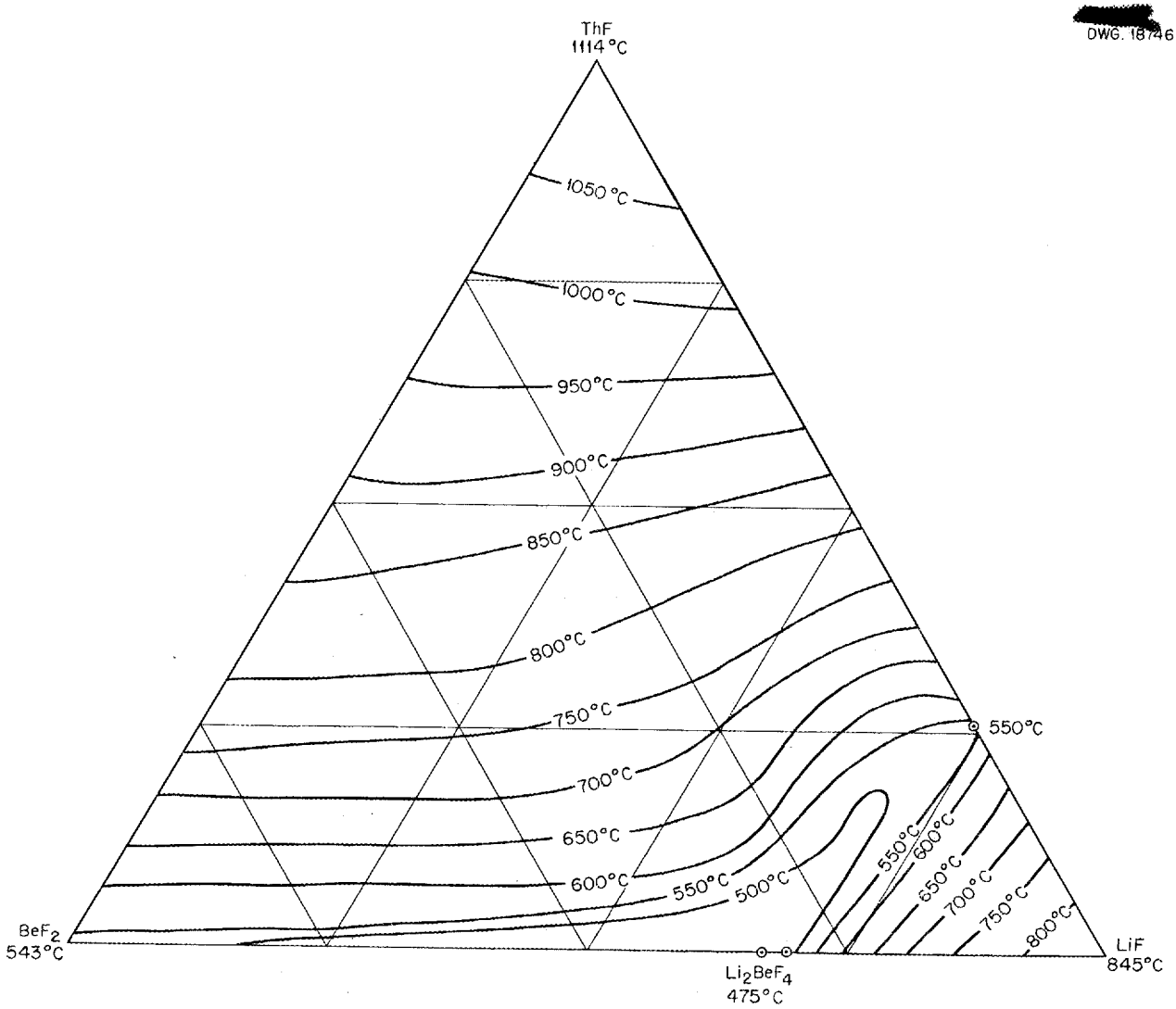
The System $NaMgF_3$–CaF_2.

[redacted]
DWG. 17406

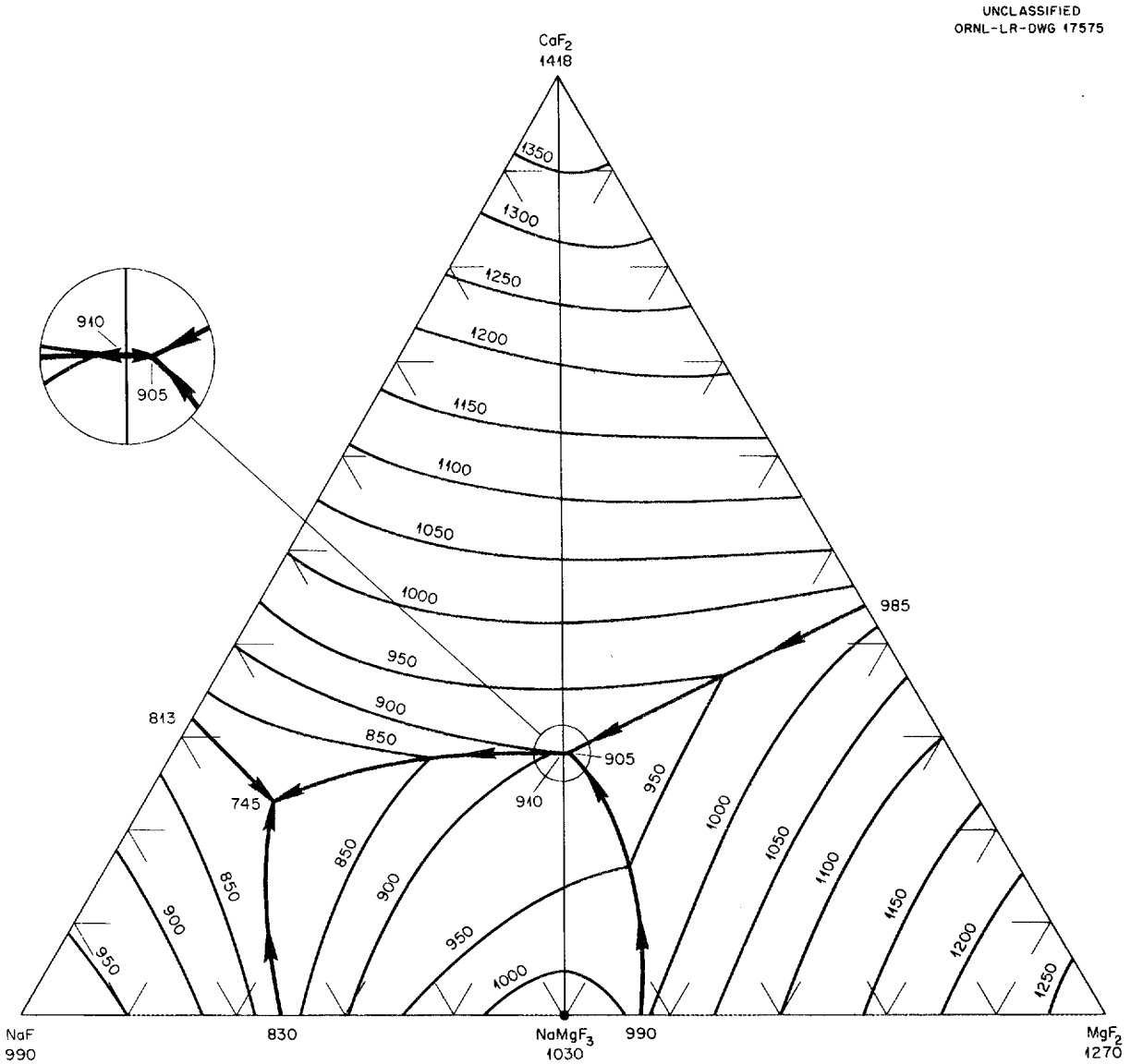


The System KF–NaF–AlF_3.

[redacted]
DWG. 18746



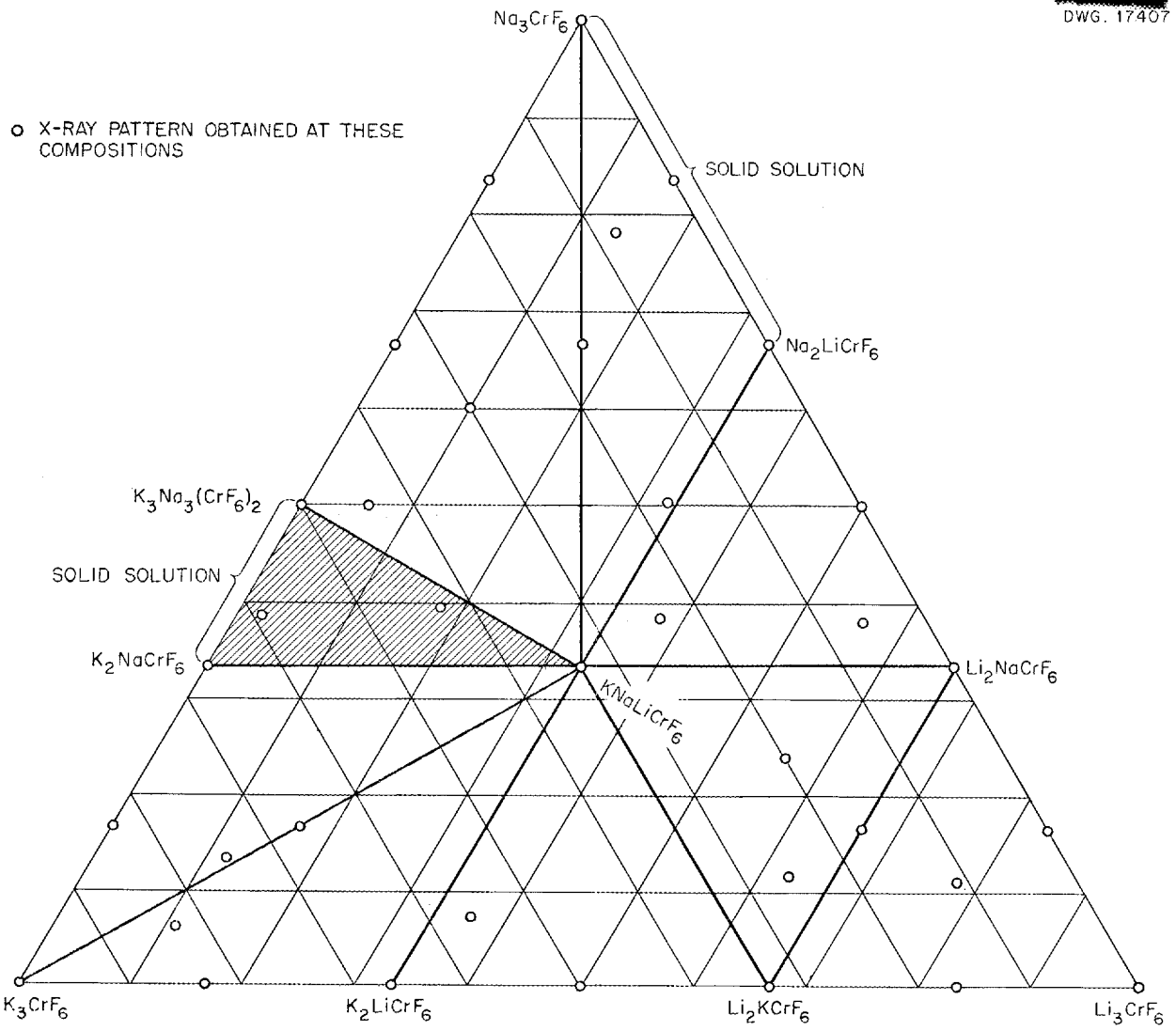
The System BeF_2–LiF–ThF_4.



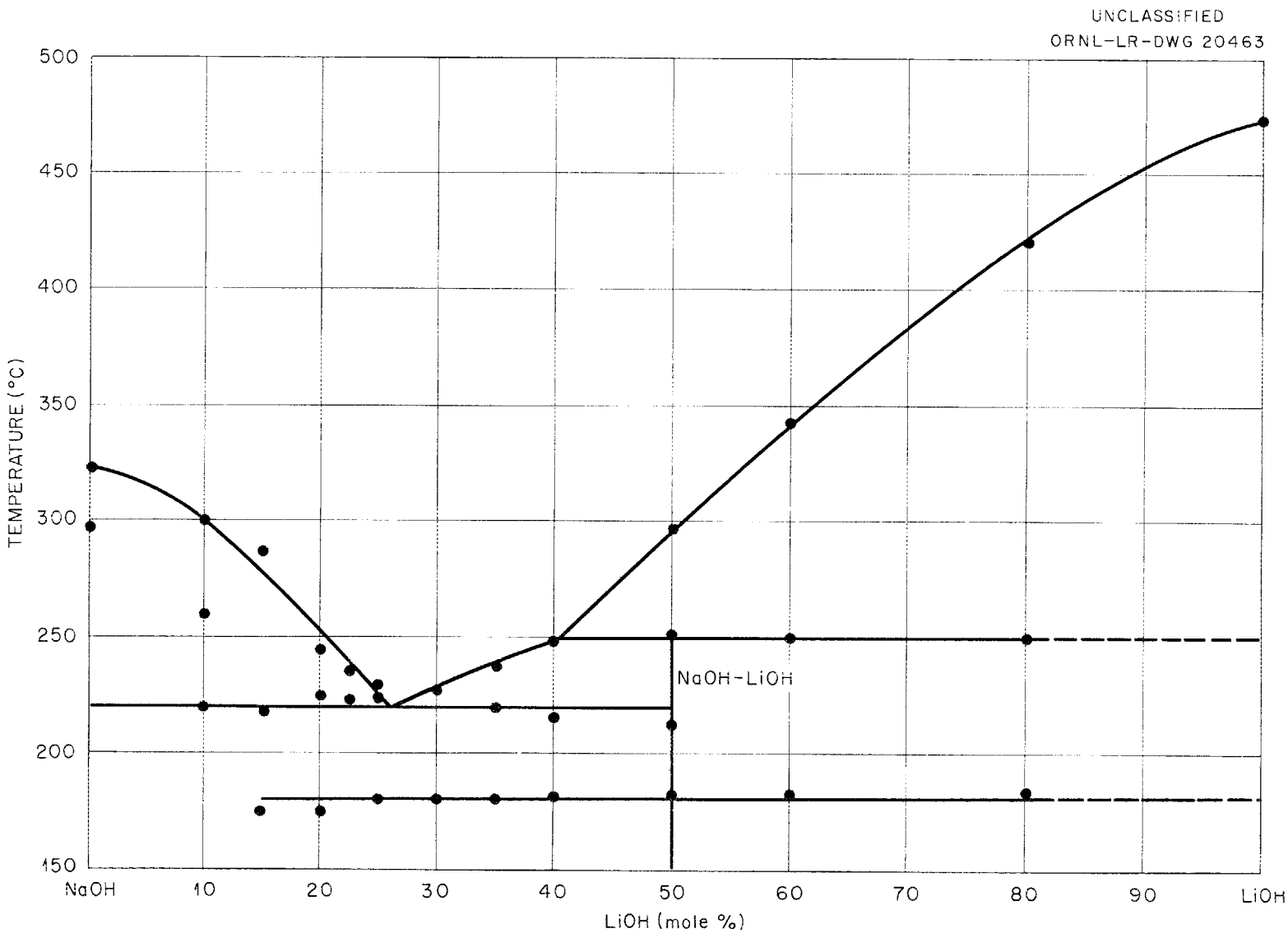
The System $NaF-MgF_2-CaF_2$.

[redacted]

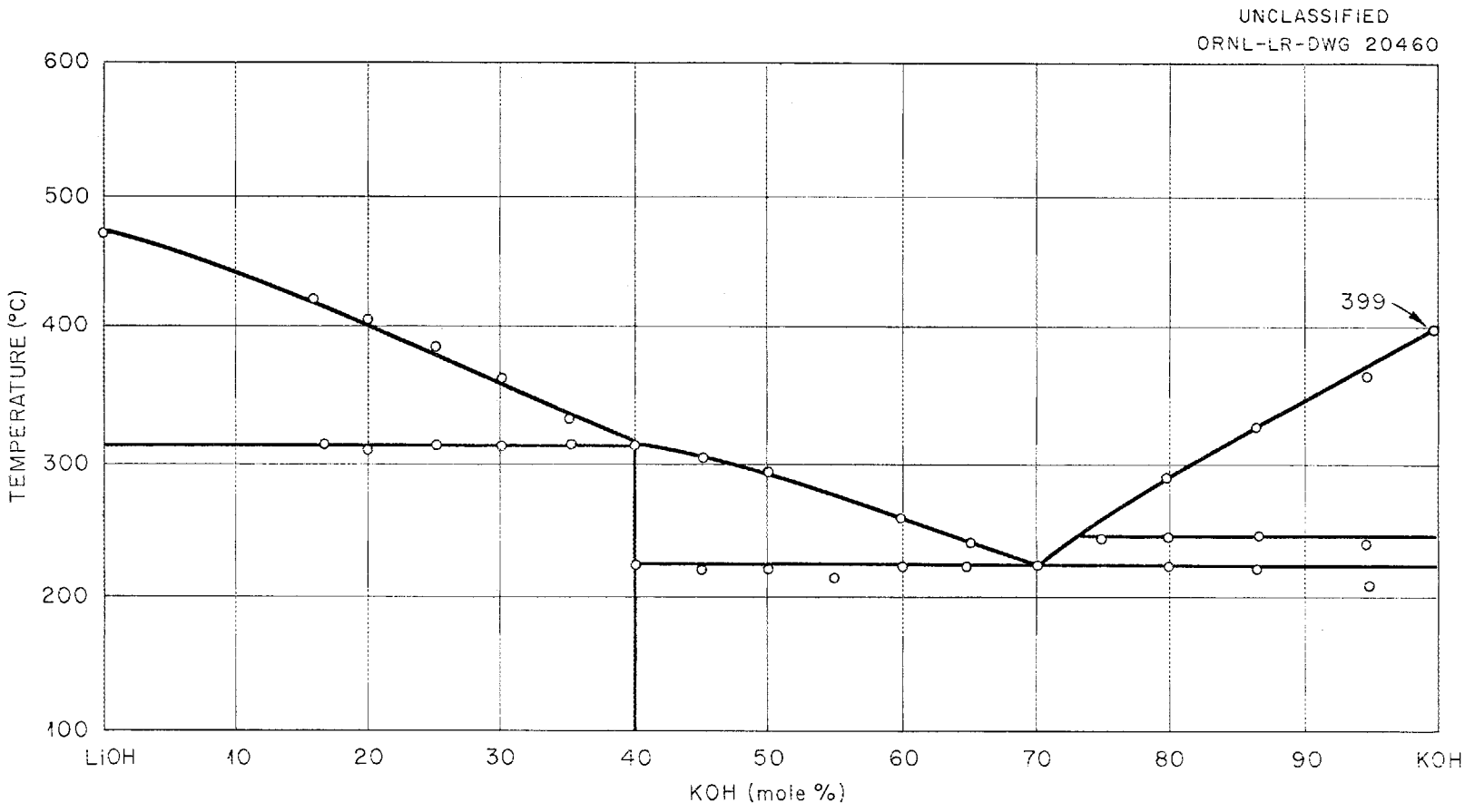
DWG. 17407



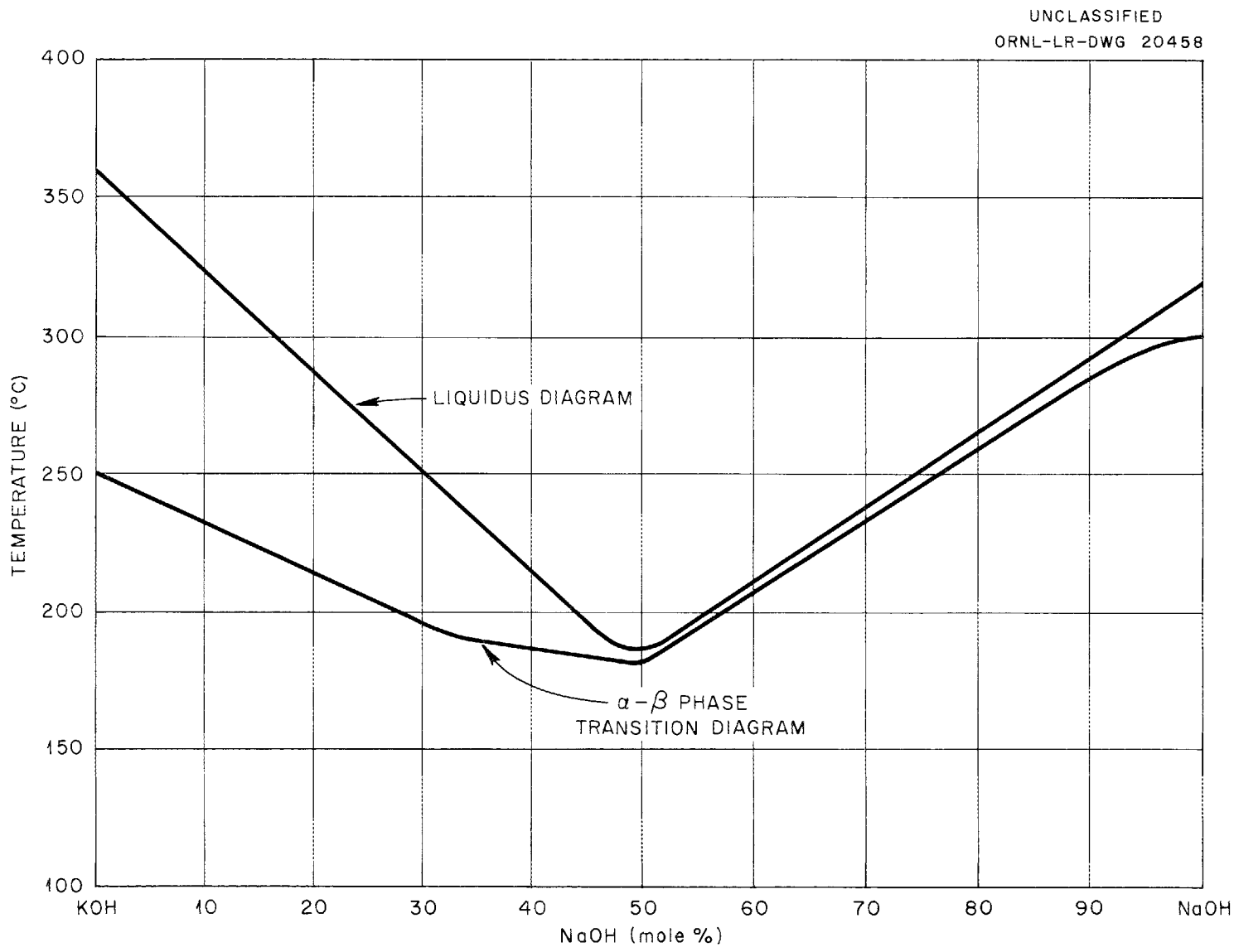
The System K_3CrF_6–Li_3CrF_6–Na_3CrF_6.



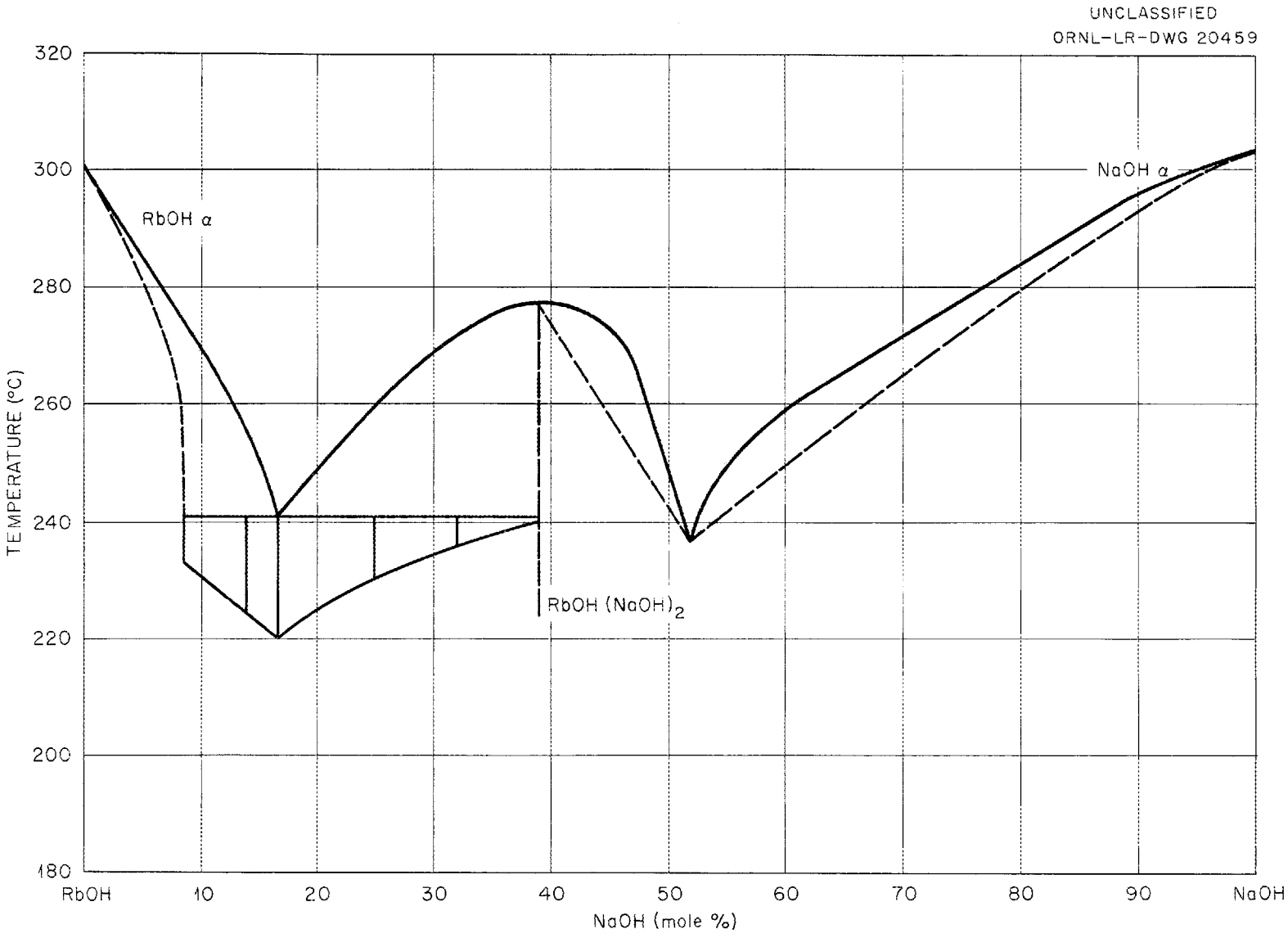
The System NaOH–LiOH.



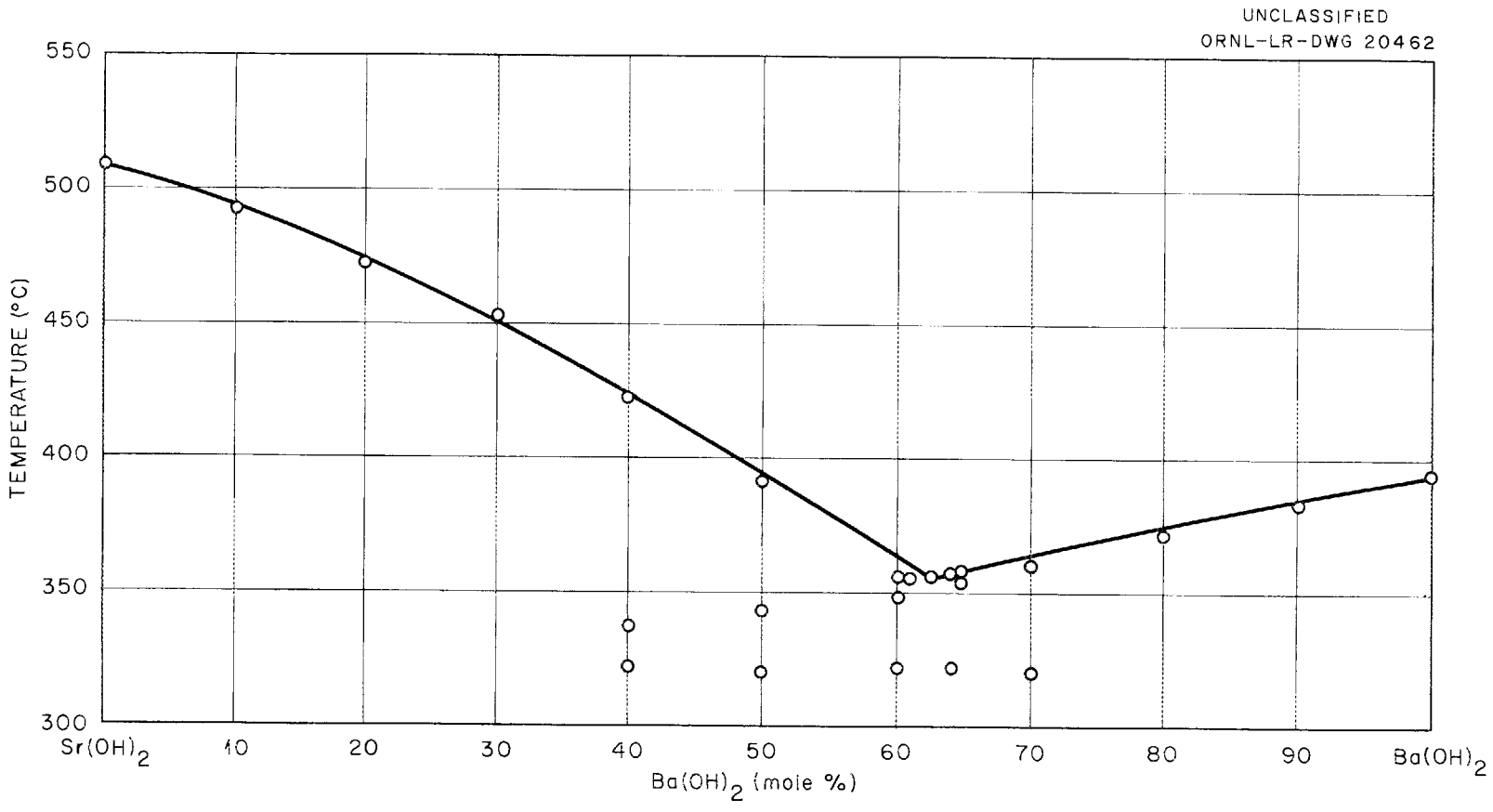
The System LiOH–KOH.



The System KOH–NaOH.



The System RbOH–NaOH.



The System $Sr(OH)_2$–$Ba(OH)_2$.