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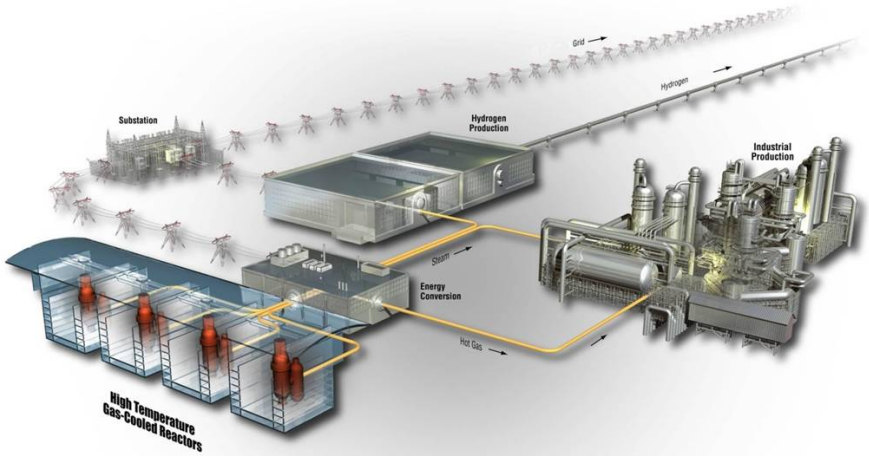
Statement of Work

Project No(s): 29412

Alloy 709 Materials Procurement



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INL ART Program	Statement of Work		

SIGNATURES			
Signature and Typed or Printed Name	Signature Code	Date (mm/dd/yyyy)	Organization/Discipline
Richard Wright	P	08/13/2020	B612/INL/Emeritus Laboratory Fellow
Richard N Wright			
Helen Guymon Digitally signed by Helen Guymon Date: 2020.08.12 16:29:25 -06'00'	A		Project Manager
Helen Guymon			
Michelle Sharp	C	08/13/2020	H330/INL Quality Engineer
Michelle T. Sharp			

P For Preparer of the document.

A For Approval: This is for non-owner approvals that may be required as directed by a given program or project.

C For documented review and concurrence.

Note Quality Level 3 (QL3)

REVISION LOG

Rev.	Date	Affected Pages	Revision Description
0	8/11/2020	All	This is a new document

CONTENTS

1. INTRODUCTION

1.1 Background

Section III Division 5 of the ASME Boiler and Pressure Vessel Code (BPVC) contains a set of rules that allow the design of metallic components for nuclear reactors that can safely operate at elevated temperatures. In addition to the design rules, that section of the Code also provides the properties necessary to carry out design calculations for the small number of materials (a current total of only six alloys) which have been qualified for such construction. The US Department of Energy, Office of Nuclear Energy, Advanced Research and Technology (ART) program is providing support for qualification of an advanced stainless steel for nuclear design and construction of components under Section III Division 5 of the BPVC. Qualifying this material, Alloy 709, requires extensive property characterization from at least three commercial scale heats. This procurement represents one of those required batches of the alloy.

1.2 Purpose/Objectives

Qualifying a new material for design and construction of elevated temperature nuclear components under Section III Division 5 of the BPVC requires measurement of a variety of properties, including tensile, creep, fatigue and creep-fatigue behavior in the relevant temperature range, and from the relevant product form, from a commercial scale heat. For the ART program the desired product form is hot rolled plate. This procurement is for a unique composition of stainless steel for which a commercial scale heat represents melting about 50,000 pounds of the alloy, resulting in about 45,000 pounds of usable plate. The Alloy 709 plate from this purchase will be provided to INL, Argonne National Laboratory and Oak Ridge National Laboratory for characterization of the relevant properties to support Code qualification.

1.3 Anticipated Benefits

The intent of procuring this heat of Alloy 709 is to facilitate property characterization to support qualification for Section III Division 5 of the ASME BPVC. Qualification of this material will enable design and construction of components for new elevated temperature reactor concepts that are not possible using the current very limited set of qualified materials. This might include more efficient and longer-lived sodium cooled fast spectrum reactors or entirely new concepts for reactors that have novel molten salt coolant.

2. APPLICABLE CODES AND REFERENCES

2.1 For general requirements: ASTM A480-16, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat- Resisting Steel Plate, Sheet, and Strip

2.2 For flatness: ASTM A480-99b, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

3. SCOPE

3.1 Work to be Performed

Production of approximately 45,000 pounds of the stainless-steel alloy 709 will be produced.

3.2 Introduction

U.S. Department of Energy, Office of Nuclear Energy's Advanced Reactor Technologies Program is conducting research and development to qualify an advanced austenite stainless steel, Alloy 709, for ASME Section III Division 5 Constructions. Qualification of Alloy 709 will be used in the support of development and deployment of sodium fast reactors.

3.3 Chemistry

The product chemistry shall conform to the ranges or maximum values specified in wt % in Table 1. The goal for the product chemistry is to conform to the aims given in wt % in Table 1, and the additional restriction to the residual elements specified in this Section (3.3), both on a best effort basis.

Table 1. Product Chemistry

wt %	C	Mn	P	Si	Cr	Ni	Mo	N	Nb	Ti	B	Fe
Max or Range	0.04-0.10	1.5	Note (1)	1.00	19.5-23	23-26	1.0-2.0	Note (2)	0.1-0.4	0.04	0.002-0.010	Note (3)
Aim	0.07	0.9	Note (4)	0.40	20	25	1.5	0.15	0.25	<0.04	Note (5)	

Note (1): The P not to exceed 0.025 wt %
Note (2): The N controlled to the range 0.13 – 0.17 wt %
Note (3): Balance
Note (4): Less than 0.015 wt % or as low as possible
Note (5): Boron aim is 0.004 wt %

Additionally, the residual elements are restricted to:

- S controlled to 0.002 wt % or less

- Cu controlled to 0.50 wt % or less
- Co controlled to 0.10 wt % or less
- Al not to exceed 0.03 wt %

3.4 Plates

Approximately 80 % of the electro-slag remelted (ESR) slab shall be hot-rolled per ATI mill practice to 1.75" thick plates approximately 56" in width. The remaining product (~20%) of the product shall be retained at 2" thickness and approximately 56" wide. All but one of the plates shall be solution annealed for an appropriate time at a temperature which will recrystallize the material and result in a final grain size in the range of 4-7 ASTM grain size number. One of the 1.75" thick plates will not be annealed and will be delivered in the as-rolled condition with mechanical and microstructure results reported as "information only" on the Certified Material Test Report.

After solution anneal, the plates shall be water-quenched, iron grit blasted, and roller leveled. Surfaces are to be pickled. The as-rolled plate will receive the same treatment except it will not be water-quenched as it will not be annealed.

Each piece shall be ink marked in two (2) places with grade, heat number, gauge, size, heat treatment condition and final rolling direction.

3.5 Work Excluded

Work not specifically identified to be performed in this statemen of work.

3.6 Requirements

The subcontractor shall do the following:

- Implement the company's safety and health requirements as required to complete this work.
- Implement the company's environmental requirements as required to complete this work.
- Perform all machining work per Section 3.1 at the subcontractor's facility.
- Ship the Alloy 709 plates conforming to Section 3.3 and 3.4 to the INL.

3.7 Place of Performance

ATI Flat Rolled Products
1300 Pacific Avenue
Natrona Heights, PA 15065
USA
Bridget Barton
724-229-3744

724-226-6575
Bridget.Barton@ATImetals.com

3.8 Interfaces

Interfaces will be between Richard Wright, INL, and Bridget Barton, ATI Flatt Rolled Products as the technical representatives.

3.9 Miscellaneous

Not applicable.

4. DELIVERABLES

4.1 The deliverables are:

- ESR plates listed in Section 3.4
- Certified material test report

The plates shall be delivered to Idaho National Laboratory at the address listed below:

Attention: Dr. Richard N Wright
Idaho National Laboratory
North Boulevard
Idaho Falls, ID 83404
Tel: 208-709-9255

5. SCHEDULE AND MILESTONES

The material shall be delivered within 16 weeks from ATI receipt of the order.

6. COMPLETION CRITERIA AND FINAL ACCEPTANCE

The deliverables shall conform to the chemistry and processing requirements stated in Sections 3.3 and 3.4 of this Statement of Work.