+Call for Expertise: エキスパート募集
IO References: IO/24/CFE/10028500 /JLE
"Propellant Modelling for DMS"
（DMS のための推進ガスモデリング）
IO 締め切り 2024 年 5 月 3 日(金)

概要：
イーター機構（IO）では、上記タスクの支援をいただく作業を ITER 参加極の企業・機関等から募集します。応募を希望される企業・機関等は、所定の期限までに応募書類を直接 ITER 機構の下記担当までご提出下さい。

○ 今回の募集に関する書類は以下の通りです。
・招待状
・技術仕様書
・履歴書（CV）テンプレート
・見積もり提案書テンプレート
・誓約書
・守秘義務に関する誓約書(契約締結時に署名されること)

○ 応募者は、以下の申込用紙を ITER 機構に直接送付願います。
・履歴書（ITER 機構の招待状と技術仕様書で規定した要求事項と基準を満足していることを示す経験について明記されていること）
・誓約書（署名入り）
・見積もり提案書
（※提出書類は pdf ファイル 1 本にまとめて送付願います。）

○ 応募書類の提出先
ITER 機構の下記担当者宛に電子メールにて送付：
連絡先：**Jong-Eun LEE**
Procurement & Contracts Division
ITER Organization
電話：+33 4 42 17 6281
E-mail: Rossella.Muzzetto@iter.org

〇はじめに

この事前情報通知（PIN）は、供給契約の審査および実行につながる公開入札調達プロセスの最初のステップです。この文書の目的は、作業範囲と入札プロセスに関する技術的内容の基本的な概要を提供することです。

〇背景

ITER プロジェクトは、欧州連合（EU）(EURATOM を代表とします）、日本、中華人民共和国、インド、韓国、ロシア連邦、米国の 7 カ国が共同出資する国際的な研究開発プロジェクトで、ITER 機構（IO）の本部（HQ）があるヨーロッパ、フランス南部のサン・ポール・レ・デュランスで建設されています。

ITER プロジェクトの組織面および技術面の詳細については、www.iter.org を参照してください。

〇作業範囲

「DMS のための推進ガスモデリング」と題した本契約の目的は、技術仕様書に記載されたサービスの提供を調達することです。詳細は技術仕様書 ref. AS6PDQ_v 1.1 (本 PIN 文書の附則 I)を参照下さい。

〇調達プロセスと目的

目的は、競争入札プロセスを通じて供給契約を落札することです。

この入札のために選択された調達手続きは公開入札手続きと呼ばれます。

オープン入札手順は、次の 4 つの主要なステップで構成されています。

- ステップ 1-事前情報通知（PIN）

  事前情報通知は公開入札プロセスの第一段階です。IO は、関心のある候補企業に対し、10 作業日までに担当調達担当官に以下の情報を提出し、競争プロセスへの関心を示すよう正式に要請します。

  -候補会社の名称

  -登録国

  -連絡先の名前、電子メール、タイトル、電話番号。

  特に注意:

  関心のある候補企業は、IO Ariba の電子調達ツール 「IPROC」 に登録してください（まだ登録していない場合）。手順については、https://www.iter.org/fr/proc/overview を参照してください。

Ariba (IPROC) に登録する際には、お取引先様に最低 1 名の担当者の登録をお願いします。この連絡担当者は、提案依頼書の発行通知を受け取り、必要と思われる場合は入札書類を同僚に転送することができます。

- ステップ 2-入札への招待
  関心のある候補企業の完全登録後、提案依頼書（RFP）を 「IPROC」 に掲載します。この段階では、担当の調達担当者に関心を示し、かつ IPROC に登録している関心のある候補企業は、RFP が公表された旨の通知を受けることができます。その後、RFP に詳述されている入札説明書に従って提案書を作成し、提出します。

  このツールに登録されている企業のみが入札に招待され、登録されている企業は、自社の名前でのみ提案を提出できます。

- ステップ 3-入札評価プロセス
  入札者の提案は、IO の公平な評価委員会によって評価されます。入札者は、技術的範囲に沿って、かつ、RFP に記載された特定の基準に従って作業を実施するために、技術的遵守を証明する詳細を提供しなければなりません。

- ステップ 4-落札
  認定は、公開されている RFP に記載されている、コストに見合った最適な価格または技術的に準拠した最低価格に基づいて行われます。

〇概略日程

概略日程は以下の通りです：

マイルストーン	暫定日程
IOWeb ページと DA との連絡により 事前指示書（PIN）の発行	2024 年 4 月 23 日
関心表明フォームの提出	2024 年 5 月 3 日
IPROC での提案リクエスト（REP）の発行	2024 年 5 月 13 日
IPROC で入札提出	2024 年 5 月 28 日
入札評価と契約授与	2024 年 6 月
契約調印	2024 年 6 月
契約開始	2024 年 6 月

〇契約期間
予想される契約期間は、12 か月です。

〇経験
入札者は、IO の技術的要件に沿った期待される支援を提供するにあたり、その知識と経験と能力があることを英語で示す必要があります。ITER での使用言語は英語です。流暢でプロレベルが必要です（スピーキングとライティング共に)。

〇候補
参加は、個人またはグループ/コンソーシアムに参加するすべての法人に開放されます。法人とは、法的権利及び義務を有し、ITER加盟国内に設立された個人、企業又は機構をいいます。

法人は、単独で、またはコンソーシアムパートナーとして、同じ契約の複数の申請または入札に参加することはできません。共同事業体は、恒久的な、法的に確立されたグループ又は特定の入札手続のために非公式に構成されたグループとすることができます。
コンソーシアムのすべての構成員(すなわち、リーダーと他のすべてのメンバー)は、ITER機構に対して連帯して責任を負います。

コンソーシアムとして許可されるために、その点で含まれる法人はコンソーシアムの各メンバーをまとめる権限をもつリーダーをもたなければなりません。このリーダーはコンソーシアムの各目メンバーのために責任を負わなければなりません。

指名されたコンソーシアムのリーダーは、入札段階でのカバーレター(入札への招待)で、コンソーシアムのメンバーの構成を説明する予定です。その後、候補者の構成は、いかなる変更もITER機構に通知することなく変更してはなりません。かかる認可の証拠は、すべてのコンソーシアムメンバーの法的に授権された署名者が署名した委任状の形式で、しかるべき時期にIOに提出しなければなりません。

どのコンソーシアムメンバーもIPROCに登録する必要があります。

【※ 詳しくは添付の英語版技術仕様書「**Propellant Modelling for DMS**」をご参照ください。**】**
ITER 機構のウェブサイト
http://www.iter.org/org/team/adm/proc/overview からもアクセスが可能です。

「核融合エネルギー研究開発部門」の HP： http://www.fusion.qst.go.jp/ITER/index.html
では ITER **機構からの各募集（**IO **職員募集、**IO **外部委託、**IO **エキスパート募集）を逐次更新しています。ぜひご確認ください。**

PRIOR INFORMATION NOTICE (PIN)

IO/24/CFE/10028500/JLE

Propellant Modelling for DMS

Procurement Officer in charge:

Jongeun LEE
Jongeun.lee@iter.org

Abstract.

The purpose of this summary is to provide prior notification of the IO′s intention to launch a competitive Call for Expertise process in the coming weeks. This summary provides some basic information about the ITER Organisation (the "IO"), the technical scope for this tender, and details of the tender process.

1 Introduction

This Prior Information Notice (PIN) is the first step of a Call for Expertise Procedure leading to the award and execution of a Service Contract.

The purpose of this document is to provide a basic summary of the technical content in terms of the scope of work, and the tendering process.

2 Background

The ITER project is an international research and development project jointly funded by its seven Members being, the European Union (represented by EURATOM), Japan, the People's Republic of China, India, the Republic of Korea, the Russian Federation and the USA. ITER is being constructed in Europe at St. Paul–Lez-Durance in southern France, which is also the location of the headquarters (HQ) of the ITER Organization (IO).

For a complete description of the ITER Project, covering both organizational and technical aspects of the Project, visit www.iter.org.

3 Scope of Service

The purpose of this Contract titled "**Propellant Modelling for DMS**" is to procure the provision of services described in the Technical Specifications, ref. **AS6PDQ_v 1.1 (ANNEX I in this PIN document).**

4 Procurement Objective & Process

The objective is to award a Contract through a competitive bidding process.

The procedure is comprised of the following four main steps:

- Step 1- Prior Information Notice (PIN) – publication on IO web procurement page
  The Prior Information Notice is the first stage of the process. The IO formally invites interested candidate companies to indicate their interest in the competitive process, within **10 calendar days**, by returning to the Procurement officer in charge the following information by the date indicated under paragraph 5 below:

  - Name of candidate company
  - Country of registration
  - Point of contact name, email, title, and phone number.

  Special attention:

  Interested candidate companies are kindly requested to register in the IO Ariba e-procurement tool called "IPROC", if not so done yet. The process on how to do is described at the following link: https://www.iter.org/fr/proc/overview.

  When registering in Ariba (IPROC), suppliers are kindly requested to register at least one contact person. This contact person will be receiving the notification of publication of the Request for Proposal and will then be able to forward the tender documents to colleagues if deemed necessary.

- Step 2 - Request for Proposals
  After the full registration of interested candidate companies, the Request for Proposals (RFP) will be published in "IPROC". This stage allows interested candidate companies who have indicated their interest to the Procurement Officer in charge AND who have registered in IPROC to receive the notification that the RFP is published. They will then prepare and submit their proposals in accordance with the tender instructions detailed in the RFP.

  Only companies registered in this tool will be invited to the tender and registered company can only submit a proposal in their name.

- Step 3 – Tender Evaluation Process

  Tenderers proposals will be evaluated by an impartial evaluation committee of the IO. Tenderers must provide details demonstrating their technical compliance to perform the work in line with the technical scope and in accordance with the particular criteria listed in the RFP.

- Step 4 – Contract Award
  The award will be done on the basis of best value for money or lowest price technically compliant offer as described in the published RFP.

5 Procurement Timetable

The tentative timetable is as follows:

Milestone	Date
Publication of the Prior Indicative Notice (PIN) on IO Webpage and communications with DAs	23 April 2024
Deadline for Submission of expression of interest form	**3 May 2024**
Request for Proposals (RFP) publishing on IPROC	13 May 2024
Tender Submission in IPROC	**28 May 2024**
Tender Evaluation & Contract Award	June 2024
Contract Signature	June 2024
Contract Commencement	June 2024

6 Contract Duration and Execution

The estimated contract duration shall be 12 months.

7 Experience

The tenderers shall demonstrate their knowledge, experience and capabilities in the implementation of providing expected supports in accordance with the IO technical requirements.

The working language of ITER is English, and a fluent professional level is required (spoken and written).

8 Candidature

Participation is open to all legal entities participating either individually or in a grouping/consortium. A legal entity is an individual, company, or organization that has legal rights and obligations and is established within an ITER Member State.

Legal entities cannot participate individually or as a consortium partner in more than one application or tender of the same contract. A consortium may be a permanent, legally established grouping, or a grouping which has been constituted informally for a specific tender procedure. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization.

In order for a consortium to be acceptable, the individual legal entities included therein shall have nominated a leader with authority to bind each member of the consortium, and this leader shall be authorised to incur liabilities and receive instructions for and on behalf of each member of the consortium.

It is expected that the designated consortium leader will explain the composition of the consortium members in its offer. Following this, the Candidate's composition must not be modified without notifying the ITER Organization of any changes. Evidence of any such authorisation shall be submitted to the IO in due course in the form of a power of attorney signed by legally authorised signatories of all the consortium members.

Any consortium member shall be registered in IPROC.

9 Sub-contracting Rules

Sub-contracting is not allowed.

IDM UID

AS6PDQ

VERSION CREATED ON / VERSION / STATUS

15 Mar 2024 / 1.1 / Approved

EXTERNAL REFERENCE / VERSION

Technical Specifications (In-Cash Procurement)

Technical Specification - CFE Propellant Modelling for DMS

Technical Specification on Propellant Modelling for DMS
(planned as a Call for Expertise (CFE) contract)

SERVICE

Table of Contents

SERVICE

1 Preamble

This technical specifications are to be read in combination with [AD1] that constitutes a full part of the technical requirements. In case of conflict, the content of the Technical Specification supersedes the content of [AD1].

2 Purpose

The purpose of this technical specification (ITER_D_AS6PDQ) is to provide CFD analysis and design details for the DMS injector.

3 Acronyms & Definitions

3.1 Acronyms

The following acronyms are the main ones relevant to this document.

For a complete list of ITER abbreviations see: ITER Abbreviations (ITER_D_2MU6W5).

Acronym	Meaning
CAD	Computer Aided Design
CFD	Computational Fluid Dynamics
DMS	Disruption Mitigation System
PIC	Protection Important Component
SPI	Shattered Pellet Injector

3.2 Definitions

Site or ITER Site or IO Site: Covers the Construction site and Areas under Operation. By extension, any place where IO staff is operating on a regular basis is to be considered ITER Site, if specified as such by IO.

Offsite: Anywhere that is not ITER Site.

Contractor: Shall mean an economic operator who have signed the Contract in which this document is referenced.

4 Applicable Documents & Codes and standards

4.1 Applicable Documents

It is the responsibility of the Contractor to identify and request for any documents that would not have been transmitted by IO, including the below list of reference documents.

These technical specifications take precedence over the referenced documents. In case of conflicting information, this is the responsibility of the contractor to seek clarification from IO.

Upon notification of any revision of the applicable document transmitted officially to the contractor, the contractor shall advise within four weeks of any impact on the execution of the contract. Without any response after this period, no impact will be considered.

SERVICE

Ref	Title	IDM ID	Version
[AD1]	General Management Specification for Service and Supply	82MXQK	1.4
[AD2]	Project Requirements	27ZRW8	6.3
[AD3]	System Requirement Document (SRD) 18.DM	BEJQWA	2.4
[AD4]	Defined requirements PBS 18 DMS	45P8YK	2.3
[AD5]	18.DM System Design Description for DMS	2NC6CB	2.1
[AD6]	Safe Access for Maintainability	RUGWUK	1.4
[AD7]	Working Instruction for the Qualification of ITER safety codes	258LKL	3.1
[AD8]	ITER Human & Organizational Factors Policy	QUK6LF	1.1
[AD9]	ITER Abbreviations	2MU6W5	1.17
[AD10]	Software Qualification Policy	KTU8HH	2.0
[AD11]	Quality Classification Determination	24VQES	5.2
[AD12]	Order dated 7 February 2012 relating to the general technical regulations applicable to INB - EN	7M2YKF	1.7
[AD13]	Template for CFD analysis reports	TL7H73	1.1

4.2 Applicable Codes and Standards

It is the responsibility of the contractor to procure the relevant Codes and Standards applicable to that scope of work.

However, there are no particular Codes and Standards identified for the work under the scope of these technical specifications.

Ref	Title	Doc Ref.	Version
-	-	-	-

5 Scope of Work

5.1 Introduction

This section defines the specific scope of work for the service, in addition to the contract execution requirement as defined in [AD1].

The DMS will consist of 27 identical Shattered Pellet Injectors (SPI), which serve as fast plasma shutdown system in case of plasma disruptions. These SPIs launch cylindrical pellets consisting of solid cryogenic neon, hydrogen, deuterium or mixtures thereof. These pellets are created by injecting the gases into a circular tube that is cooled by supercritical helium to a temperature of 5K (cold head). The gas desublimates on the wall of the cold head, forming a cylindrical plug (pellet). A fast valve at one end of the cold head provides a propellant gas pulse that breaks the pellet from the wall of the cold head and accelerates the pellet on a millisecond time scale. The pellet then travels through two suppressor volumes that hold back close to all of the propellant gas. The pellet is then shattered into fragments that enter the plasma, sublimate and radiating the plasma’s thermal energy over a larger surface. This reduces the thermal loads on the plasma

SERVICE

facing components and increases their overall lifetime. Figure 1 shows a typical injector assembly in one of the equatorial ports.

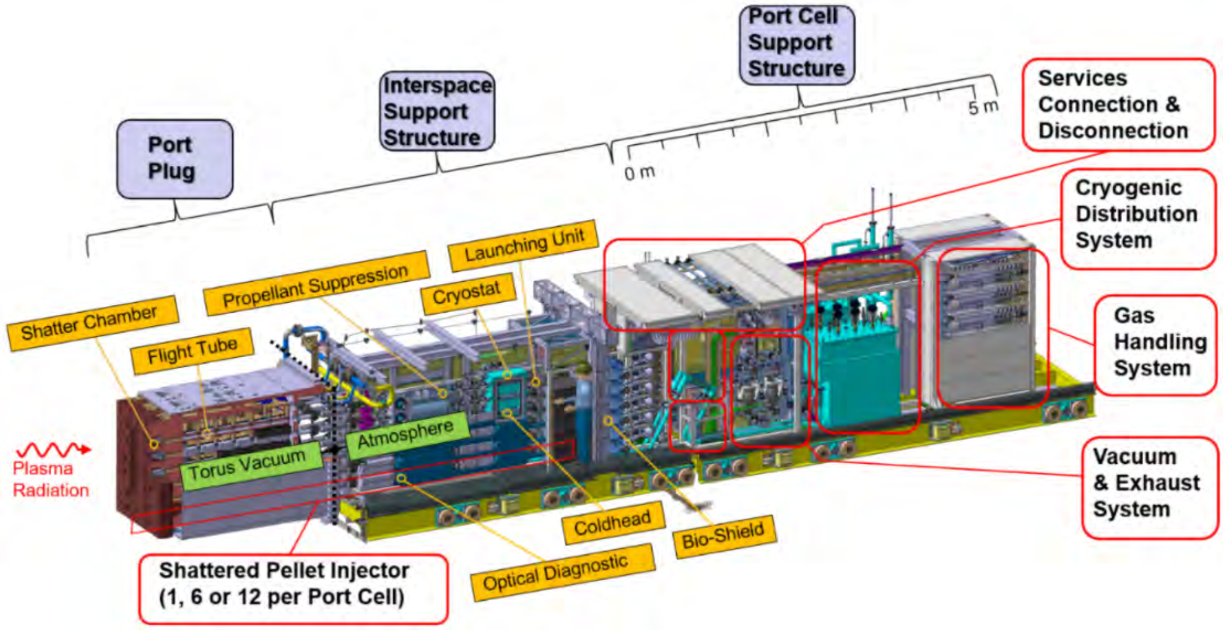

Figure 1 CAD of the Injector for an ITER equatorial port (a total of 12 injectors in this port).

The fast valves are filled with up to 6 MPa hydrogen to generate enough force to break the pellet from the wall of the cold head and to accelerate it quickly to a speed that allows the pellet to travel the distance between the cold head and the plasma before the disruption occurs. Furthermore, the pellet is sitting in the cold head after its generation, waiting to be launched. Therefore, the interior of the cold head is under vacuum at about 10^{-2} Pa after the pellet has formed.

When the pellet is launched, the fast valves opens within 1-2 ms and releases the high-pressure propellant gas from the valve's internal gas reservoir into the volume of the cold head between the fast valve and the pellet. This volume is called the breech volume.

The pressure build up in the breech volume is decisive for a successful pellet launch. A fast pressure buildup can lead to a punch on the pellet that destroys it before launch. A slow pressure build up makes synchronisation of the 27 injectors difficult. Previous CFD studies and experiments at Oak Ridge National Laboratory have helped to optimize the breech volume geometry. However, the effect of the opening in the breech volume for the pellet gas feed have been neglected so far.

The pellet is then accelerated along the barrel to speeds between 200 m/s and 500 m/s. As the pellet leaves the barrel it starts to rotate around an axis perpendicular to the flight path. This has been observed in experiments at CEA Grenoble and the Center for Energy Research in Budapest. Recent CFD analysis indicates that the rotation is induced by the propellant gas plume following the pellet at the barrel exit, which is enacting a force on the non-planar back surface of the pellet. In an effort to counteract this effect, the final segment of the barrel has radial openings that allow the propellant gas to expand into the first expansion volume, thus reducing the backing pressure of the pellet while it is still guided in the barrel. This section of the barrel is structurally the weakest part and may be sensitive to flow induced vibrations.

SERVICE

After the pellet injection or after pellet regeneration, the injectors are filled with hydrogen. Small leaks in the containment or at flange seals may introduce oxygen, leading to an explosive mixture. Even though the injectors are free of ignition sources, the effects of an internal combustion have to be determined, especially regarding effects on the Torus Isolation valves (TIVs).

The scope of work includes multiple transient CFD calculations in 2D and 3D to investigate explosions inside the injector volumes, resolve the flow field around the barrel openings and further explore the propellant gas expansion into the breech volume. Furthermore, the experimental efforts of the support lab regarding the propellant suppressor shall be accompanied by CFD analysis to benchmark models against experiments. More details are in section 5.2.

5.2 Engineering Analysis

5.2.1 Explosion Analysis

The work on the explosion analysis will focus on internal explosions inside the injector volumes. It is assumed that a stoichiometric mixture between hydrogen and oxygen at atmospheric pressure is present throughout the injector volumes. As the injector design has no specific ignition sources, it is assumed that an ignition can take place everywhere inside the volumes.

The effects of explosions shall be investigated for the most critical parts of the injectors, the TIVs, the double window of the Optical Pellet Diagnostic and the wall of the stage B volume.

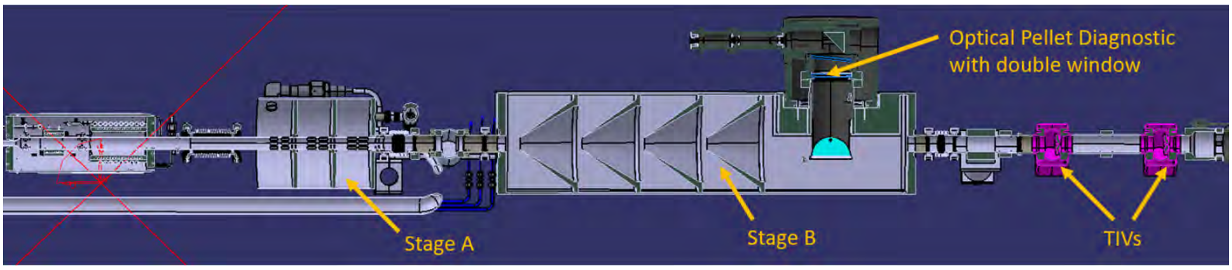

Figure 2: Section through the injector

A 2D axisymmetric representation of the injector shall be used for simplicity. Only if results indicate a 3D effect a transition to a 3D domain may be in order. To further simplify the model, the injector may be reduced to the stage B volume with its internal structures, the double window and the first TIV.

The transient simulation shall have enough temporal and special resolution to observe the expansion of the shockwave throughout the domain, the effects of the internal structures and the forces acting on the critical components. All bodies and the gas mixture may be at room temperature. The boundaries of the domain can be assumed as rigid. Flow velocities prior to the explosion shall be zero. Pressure, temperature and gas concentration are homogeneous in the domain prior to the explosion.

The aim of the transient simulation is to investigate the forces acting on the critical components.

The tasks to be carried out in the frame of this contract are the following:

- Create 2D transient case with relevant geometric features
- Perform transient simulations ignition sources at different locations in the domain

SERVICE

5.2.2 CFD support for experimental campaign

The support laboratory will conduct experiments with different suppressor configurations in their pellet test lab. These configurations are based on previous CFD results that appear promising for propellant gas retention. However, CFD results for the specific configurations have not yet been performed. A direct comparison between simulation results and experimental results would justify the ITER injector design before prototyping.

The test suppressor in the support laboratory is a cylindrical volume (Di=234 mm, L = 1170 mm) that can hold various different structures inside. The structures are foreseen to be axisymmetric. Hence, a 2D axisymmetric model, which includes the pellet in motion, the barrel exit, the suppressor in a relevant configuration and the suppressor outlet.

The transient simulation shall have enough temporal and special resolution to observe the gas expansion into the suppressor volume, showing flow velocity and pressure fields. Pressure measurement points shall be at the same locations as in the test suppressor. The simulation time shall be long enough to observe the retention time of the gas.

Initially, the domain shall have zero flow velocity except for the gas behind the pellet in the barrel. The initial pressure in the suppressor volume shall be between 100 Pa and 1000 Pa to facilitate convergence (real pressure at 10^{-2} Pa). The initial temperature of the domain is 300K. For the boundary conditions, the walls of the domain shall be stainless steel at 300 K and the pellet can be an arbitrary material at 4 K. All surfaces can be regarded as rigid. Propellant gas shall be hydrogen at room temperature.

Optionally, 0/1D calculations can be performed prior to the CFD analysis to give an estimate of the configuration performance regarding gas retention time.

The aim of the 2D axisymmetric simulations is to investigate the flow field in the test suppressor alongside the experiments. This is necessary to have a direct comparison between simulation and experiment, which is needed as justification for the ITER design.

The tasks to be carried out in the frame of this contract are the following:

- Create 2D axisymmetric transient cases with given geometric parameters
- Perform transient simulations with the parameters from the experiments
- Give input for further suppressor configurations that can be tested

5.2.3 Breech volume investigation with gas inlet openings

The breech volume has been subject of intense research in the last year, resulting in the current ITER design. However, the simulation on the breech volume have always neglected the inlet openings for the pellet gas. These openings are necessary to allow the pellet gas into the barrel during pellet formation. The gas has to be injected on both sides of the cold zone as the pellet plugs up the barrel at some point during the formation. When the propellant gas is injected into the breech volume, part of the propellant gas will enter these openings and will not contribute to the pellet acceleration. This gas amount has to be quantified. The openings may also be sized or arranged differently to reduce losses.

SERVICE

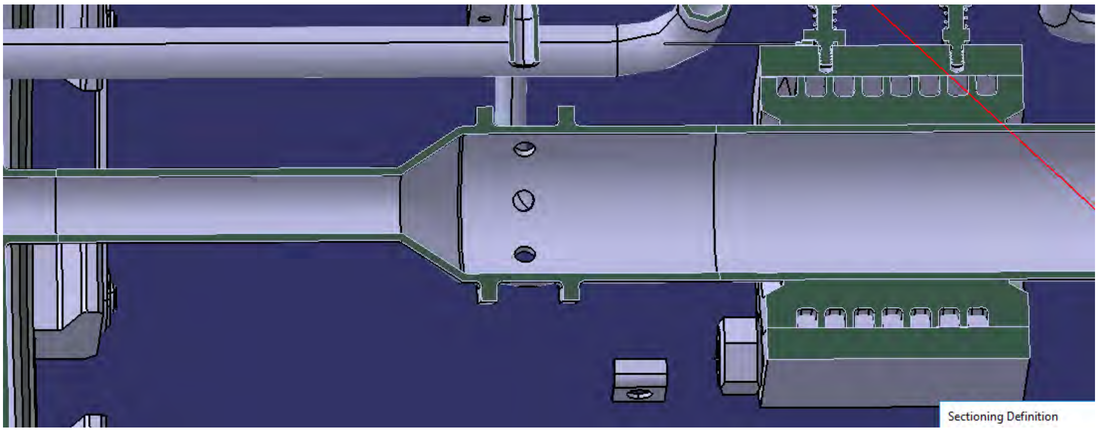

Figure 3: Section through the breech volume

The breech volume consists of a 135 mm long section with 12 mm diameter, a 12 mm long cone expanding to the diameter to 28.5 mm and a 57 mm long section with 28.5 mm diameter. The openings for the gas inlet are located 12 mm downstream of the cone and consist of 8 holes with 4 mm diameter. The holes lead to an annular volume around the barrel, which in turn is connected to a ¼” tube. This design of the gas inlet was chosen to counteract the buoyancy of H2 that was observed for a single point gas entry and that leads to a slanted pellet surface.

In a first step, the breech volume including the holes, the annular volume and the propellant valve shall be represented in a 2D axisymmetric model. In a second step, a 3D model shall be used to quantify differences between the two approaches. Following this benchmarking task, 2D axisymmetric models shall be used to investigate the impact of the hole size and the hole location. Finally, the 2D model shall be expanded with a pellet and a barrel segment leading up to the downstream gas inlet port. The simulation should then include a moving pellet to quantify the propellant gas amount that may bypass the pellet before it reaches the second gas inlet port.

Initially, the domain shall have zero flow velocity. The initial pressure in the breech volume shall be between 100 Pa and 1000 Pa to facilitate convergence (real pressure at 10^{-2} Pa). The pressure in the valve plenum shall be 60 bar. The initial temperature of the domain is 300K. For the boundary conditions, the walls of the domain shall be stainless steel at 300 K and the pellet can be an arbitrary material at 4 K. All surfaces can be regarded as rigid. Propellant gas shall be hydrogen at room temperature.

The simulation time shall be from the point of the valve opening to the pressure equilibrium between valve plenum and breech volume.

The aim of the simulations is to investigate the effect of the gas inlet openings and what can be done to minimize the loss of propellant gas without impacting the pellet formation.

The tasks to be carried out in the frame of this contract are the following:

- Create 2D axisymmetric and 3D transient cases with given geometric parameters
- Perform transient simulations with current design
- Compare 2D and 3D results to observe differences
- Create 2D axisymmetric case with reduced hole size / with different hole location
- Perform transient simulations with alternative designs
- Create 2D axisymmetric case with pellet and barrel up to second gas inlet
- Perform transient simulation
- Create a report on the findings

SERVICE

5.2.4 Barrel openings flow field

The barrel has openings in the stage A to release the majority of the propellant gas into the volume, reducing the backing pressure of the pellet and significantly reducing pellet rotation. However, the openings are structural weak spots of the barrel. The gas flow may induce vibrations in the barrel or cause pressure forces that deform the barrel. This may lead to a changed pellet trajectory and potentially loss of the pellet.

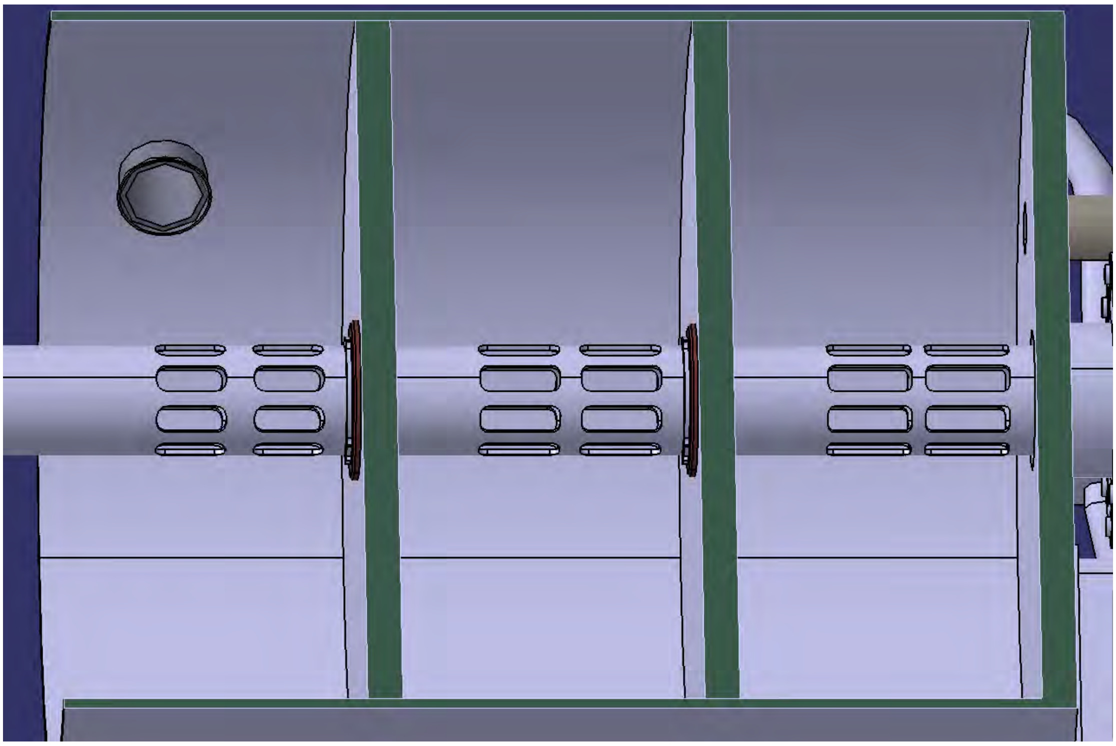

Figure 4: Section through the stage A volume

The openings in the barrel are sized to give the maximal open area for the gas to expand while the total open length must be shorter than one pellet length to prevent propellant gas overtaking the pellet. The openings are have different shapes in each compartment due to the different internal pressures at the different expansion stages.

In a first step, a 2D axisymmetric model shall be used to represent the barrel wall with the openings. The surrounding volume can be regarded as infinite as only the flow around the openings is of interest in this study. The forces acting on the barrel wall, flow detachments and eddies are the features that should be looked for here. In a second step, a moving pellet should be added to the model to see changes in the flow characteristics. In the final step, a 3D segment of the barrel shall be investigated to look for any 3D effects.

Initially, the domain shall have zero flow velocity, except for the flow behind the pellet. The initial pressure in the barrel and the surrounding volume shall be between 100 Pa and 1000 Pa to facilitate convergence (real pressure at 10^{-2} Pa). The barrel pressure directly before the first opening shall be 1.5 bara. The initial temperature of the domain is 300K. For the boundary conditions, the walls of the domain shall be stainless steel at 300 K and the pellet can be an arbitrary material at 4 K. All surfaces can be regarded as rigid. Propellant gas shall be hydrogen at room temperature.

The aim of the simulation is to investigate the flow field around the barrel openings and check the forces acting on the barrel wall.

The tasks to be carried out in the frame of this contract are the following:

- Create 2D axisymmetric cases with given geometric parameters

SERVICE

- Perform 2D transient simulation
- Communicate findings, suggest design changes if necessary
- Create 2D axisymmetric cases with moving pellet (and changed design if necessary)
- Perform 2D transient simulation
- Communicate findings
- Create 3D segment of barrel openings with surrounding volume
- Perform 3D transient simulation
- Create a report on the findings

5.2.5 Service Duration

The maximum expected duration for this activity is twelve months (see also Chapter 8).

6 Location for Scope of Work Execution

The Contractor will work predominantly off-site.

Note: The contractor will may be asked to be present on the ITER site for in person meetings on short notice for a non-specific number of weekdays throughout the contract period

7 IO Documents

Under the scope of work, IO will provide relevant / appropriate input documents as necessary during the course of the contract. A preliminary list of documents will be discussed during the Kick Off Meeting.

8 List of Deliverables and Due Dates

The Supplier shall provide IO with the documents and data required in the application of this technical specification, of [AD1] and any other requirement derived from the application of the contract.

The list of deliverables is available hereafter with associated due dates. The content of the deliverables has been detailed in sub-section 5.2.2

Technical Design Family (TDF)	Generic Document Title (GTD)	Further Description	Expected date (T0+X) *
Contract Management	D0 – Quality Plan	Quality Assurance Plan from the Contractor specific to the execution of the contract	T0 + 1
Report	D1 – Intermediate Progress Report #1	Report on the explosion analysis	T0 + 3
Report	D2 – Intermediate Progress Report #2	Report on Breech Volume Investigation	T0 + 6
Report	D3 – Intermediate Progress Report #3	Report on the investigations of the barrel openings	T0 + 9

SERVICE

Report	D4 – Final Report	Report on the support simulations for the compressor experiments	T0 + 12

(*) T0 = Start date of the kick-off meeting; X in months.

The Contractor is requested to prepare their document schedule based on the above and using the template available in the appendix II (click here to download) of [AD1].

9 Quality Assurance Requirements

The quality class (QC) under this contract is as per [AD3]. Chapter 8 of [AD1] applies in line with the defined QC.

10 Safety Requirements

Not Applicable

11 Specific General Management Requirements

Section 6 of [AD1] applies in full, except for section 6.4, amended with the following specific requirement:

- The Contractor shall not subcontract any part of this contract.

11.1 Contract Gates

The contract gates are defined in section 6.1.5 of GMS [AD1]. This service contract shall have the following technical gates:

- Approval of deliverable D1 by the IO Technical Responsible Officer (TRO).
- Approval of deliverable D2 by the IO TRO.
- Approval of deliverable D3 by the IO TRO.
- Approval of deliverable D4 by the IO TRO.

11.2 Work Monitoring

As stated in [AD1], the work progress will be managed as explained in sub-sections 6.1.4 for progress reports and 6.1.6 for progress meetings.

Moreover, the work monitoring can also be complementary achieved through the formal exchange of documents transmitted by emails or over IDM.

11.3 Meeting Schedule

In addition to the Progress Meetings, the Contractor shall work closely with the DMS designers from PBS 18.DM and also of other PBSs if needed. Routine technical meetings will take place to monitor work progress and approaches, discuss and decide on technical solutions, provide additional information, address hold points, and identify actions which require follow-up. These meeting will have an agenda. Actions/issues identified in these meetings will be recorded and reviewed in subsequent meetings until completed/resolved. It is duty of the Contractor to properly upload in IDM the minutes of these meetings.

On request and by agreement, additional special subject meetings will be organized.

11.4 CAD Design Requirements

Not Applicable

11.5 Specific Requirements and Conditions

The person proposed shall have at least 15 years of experience in the following areas:

- Degree in engineering, doctorate preferred.
- Experience in rarefied gas dynamics; fundamentals and simulations.
- Experience in CFD, specifically simulation of high pressure gas discharges in vacuum.
- Knowledge of dust migration studies and analysis.
- Knowledge of explosion impact and analysis.
- Previous experience of engineering analysis at fusion facilities.
- Experience of validation of complex fluid problems.
- Experience with creating technical documents and presentations.

Expression of Interest

To be returned by e-mail to: Jongeun.Lee@iter.org in copy to rossella.muzzetto@iter.org within 10 calendar days from the date of PIN published.

ITER Organization / ITER Headquarters
Procurement & Contracts Division
Route de Vinon-sur-Verdon CS 90 046
13067 St. Paul Lez Durance Cedex France

TENDER No.	**IO/24/CFE/10028500/JLE**
TENDER Title:	**Propellant Modelling for DMS**
Officer in charge:	**Jongeun LEE - Procurement Division ITER Building 81/140**

☐ We acknowledge receipt of all tender documents for the above mentioned tender.
(In event of missing documents, contact the ITER Officer in charge)

☐ We intend to submit a tender

<u>Contact Person for this solicitation Process:</u>

Name: .... Tel: ....

Position: .... E-mail address: ....

Signatory Name: ....

Company Stamp

Title: ....

Signature: ....

Date: ....