

Memorandum of Information 1																							
Clarification questions on Tender "SEM, Ref. 2023 FPL/INK 029, date 10-07-2023"																							
No.	Section nr. / subject	Question	Answer																				
1	9 - Appendices - 66	On the Appendix C03. ART 8.4 //Purchasing Conditions for Goods DELIVERY, ACCEPTANCE. It appears the penalties for late delivery, but we are not able to find any limit for delivery time, is there a limit, or a range of delivery which is either expected or acceptable. We'd like to know what's the maximum delivery time (from PO) that TNO can accept.	Correct, there is no fatal delivery time included in our Tender. We require a realistic delivery time, which includes all the regular risks you usually face. Once a delivery period has been agreed, this delivery period is considered binding. Nevertheless, the shortest possible delivery time is highly appreciated.																				
2	9 - Appendices - 66	On the Appendix C03. ART10 it is stated that the price is based on Fixed Price and one of the award criteria in the DocumentTNO_tender_2023 FPL-INK 029 ART 6 is stated that Price (TP) is one of the award criteria, but there is no reference to maximum price, price limit or price range on those documents. We'd like to know if there is a price range or price limit that TNO would expect not to surpass or a budget range.	Although the available budget is included in the documents on TenderNed, we decided not to make it public. TNO may ultimately decide not to award a contract if the winning bid is above the expected budget.																				
8.3 - Aspect "SEM imaging" - 32		Requirement R-1000-015 states: "lifetime is stated a time before full replacement of source, not tip maintenance or exchange." We would like to have definitions of: Full replacement of source (1st definition) versus tip maintenance or exchange (2nd definition).	Definition of full replacement of source: Replacement of all parts which play a role in emitting electrons and subsequently shaping, focusing and accelerating these electrons in the source column towards the target sample. Tip maintenance or exchange: Maintenance or replacement of the sem tip, which is defined to be the electron emitter part of the source (cathode).																				
3	8.5 - Aspect "Sample's and sample measurement area to be measured" - 38	Requirement Preference R-3000-095 states "The accuracy of the sample stage should be better than or equal to 1 um over a travel range of 100 mm in either X or Y direction ". and R-3000-110 states "The control of the stage shall have the following resolution:- XYZ= 0.0001 mm". Most of the instruments in the specified ranges have a DC stage, those stages do not have this kind of performance of (1 um accuracy over a travel range of 100 mm) What kind of stage is TNO expecting to get? Inferferometer or piezo stage?	TNO desires the one that meets the requirement, this is up to the supplier to select the most economical solution.																				
4	9 - Appendices - 66	Appendix D003 states "On some occasions, a large area (~2 mm x 2 mm) needs to be imaged in high detail, with resolution of 0.1 um or better." is it this 0.1 um the pixel size? Or how would this 0.1 um resolution would be measured?	The 0.1 um is indeed the required (maximum) pixel size of the resulting image. Thus each pixel in the image would correspond to a 100 nm x 100 nm area of the sample surface. The idea is that we make this large image map of say 4 mm2 before an experiment. If then after the experiment we find something unusual at a certain location we can look back and check if this was also present before the experiment, or if this is something caused by the experiment. The 0.1 um pixel size makes sure we can zoom in a decent amount on the image.																				
5	8.5 - Aspect "Sample's and sample measurement area to be measured" - 38	Preference R-3000-095 and Preference R-3000-105 are giving up to 400 Points each to more or less the same requirement. Because the first preference states " [...]the repeatability of the sample stage position should be better than or equal to 1 um". The second preference states " [...] The accuracy of the sample stage should be better than or equal to 1 um over a travel range of 100 mm in either X or Y direction". so basically both are rating for the same, except that the second preference specifies the XY range, so can we understand that the first preference is rated in ranges of movements equal or smaller than 100mm XY and the second one is only awarded if that happens over a range bigger than 100mm. And that for example an stage moving 150mm XY and 1micron accuracy in all its range will get 400 points for each, so in total 800 points for those two preferences?	To answer your question we will first clarify the difference between the two preferences. One is about repeatability, so how well does the stage return to a previously used coordinate. For example we go to a marker on a sample surface, place the marker exactly in the center of the SEM image, and determine its coordinates (A, B) as read out in the user interface. We then move to another location on the sample. Then we want to go back to the marker and therefore fill in the coordinates (A, B). The stage moves to these coordinates and we see that there is an offset between the actual sample marker position and the center of the SEM image. If we do this say 100 times, we get an average offset, which is then defined to be the repeatability of the stage. This however does not say anything about the absolute accuracy of the stage. The other preference is about absolute accuracy. This is how well the stage can perform a movement in terms of the exact distance which has been traversed. So if we say we prefer a stage which has an accuracy of 1 um or less over a travel range of 100 mm this is what is exactly meant: A stage move of 100.0000 mm, over either the X- or the Y-axis, as entered in the user interface will result in the stage moving 100.0000 mm +/- 0.001 mm. Typically these kind of high accuracies can be achieved by stages with position feedback, such as piezo driven encoder stages. Furthermore, a stage with very high accuracy will usually also have a very high repeatability. But a stage with high repeatability will not perse have a high accuracy. Your example of a stage with 150 mm travel range which can achieve 1 um accuracy over the full range of 150 mm is even better than the preference and will indeed result in 400 points for R-3000-095 and 400 points for R-3000-105, so 800 points in total for these two preferences. Another example would be a stage which has a repeatability of 2 um when moving towards a coordinate, but an accuracy of 10 um over 100 mm of travel. In this case repeated moves towards a location will result in an average deviation of 2 um from this location. But a move from location A to location B, which is in reality exactly 100.000 mm will result in a move with 100.000 mm +/- 10 um. In this case 120 points would be awarded for R-3000-095 and 0 points for R-3000-105.																				
6	8.4 - Aspect "Materials analysis" - 37	Preference R-2000-020 in Remark 2: the stated level of integration will be validated with demonstration. We'd like to know how this will be demonstrated during the tender process, by an on-line demonstration agreed with the technicians and research groups using the system, when it has to be demonstrated, will TNO provide samples to FEI Europe to run this demonstration, who do we have to contact to arrange this demo, could it be performed on site? on our demo lab (Nanoport) located at Eindhoven. The point of contact to organize this is lucia.rancel@thermofisher.com	Demonstration is here intended as validation method. This means that during SAT the functioning of this requirement is done with demonstration. The awarding is done by reviewing the presented documentation of each supplier.																				
7	6.1.1 - Sub-award criterium: Price (TP) - 25	It unclear how the lowest Total Price is being awarded. The division between 3000 and 1000 points is confusing, and even contradicting with the last line of page 26 where it says the lowest Total Price (TP) will be used to calculate the score, with max 4000. I would suggest to completely remove the 3000 and 1000 max scores and just go with the total 4000 score.	The allocation of points for Price remains unchanged. $Points = 4000 - \left(\frac{(I - LI)}{LI} \times 4000 \right)$ Below is an example of how the price criterion "Total TP" is calculated: <table border="1"> <thead> <tr> <th></th><th>TP1</th><th>TP2</th><th>Total TP (TP1 + TP2)</th></tr> </thead> <tbody> <tr> <td>Tenderer A</td><td>550.000</td><td>80.000</td><td>630.000</td></tr> <tr> <td>Tenderer B</td><td>485.000</td><td>150.000</td><td>610.000</td></tr> <tr> <td>Tenderer C</td><td>650.000</td><td>25.000</td><td>675.000</td></tr> <tr> <td>Tenderer D</td><td>500.000</td><td>75.000</td><td>575.000</td></tr> </tbody> </table> $Points\ Tenderer\ A = 4000 - \left(\frac{(630.000 - 575.000)}{575.000} \times 4000 \right) = 3.617,4$ $Points\ Tenderer\ B = 4000 - \left(\frac{(610.000 - 575.000)}{575.000} \times 4000 \right) = 3.756,5$ $Points\ Tenderer\ C = 4000 - \left(\frac{(675.000 - 575.000)}{575.000} \times 4000 \right) = 3.304,3$ $Points\ Tenderer\ D = 4000 - \left(\frac{(575.000 - 575.000)}{575.000} \times 4000 \right) = 4.000$		TP1	TP2	Total TP (TP1 + TP2)	Tenderer A	550.000	80.000	630.000	Tenderer B	485.000	150.000	610.000	Tenderer C	650.000	25.000	675.000	Tenderer D	500.000	75.000	575.000
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8	9 - Appendices - 66	Are reference projects requested?	No																				
9	8.3 - Aspect "SEM imaging" - 32	Resolution is specified differently by different manufacturers, creating false comparisons. For tenders, it is recommended to use the globally accepted ISO standard: 24597:2011 Derivative method.	TNO accepts this ISO standard as a method to determine resolution and compare resolution between manufacturers.																				

10	8.3 - Aspect "SEM imaging" - 32	R-1000-081, a stage bias of -250V to +250V is requested. Our system has a stage bias range of 0 to -2000V. There is no advantage in using a positive stage bias to reduce charging effects or improve image quality. But a bigger negative bias does give more advantages. We would request to also award maximum points to a stage bias voltage range of 0 to -2000V. If a positive stage bias is mandatory, please elaborate on the advantage it could provide so we could prevent an alternative method to achieve the same benefit.	Since we realize that both positive bias and negative bias give benefits, we will change the points count of this preference to award points for a negative stage bias such as 0 to -2000 V, and we will also award points for a positive stage bias, such as 0 to +250 V. A positive bias could be used for example to deflect secondary electrons back to the sample/stage, resulting in less artefacts and an increase of contrast in backscatter electron detectors. The original preference R-1000-081 will be split up in two preferences, R-1000-081a and R-1000-081b: New text for preference R-1000-081a: The SEM should be equipped with a negative stage bias with a tuneable range between at least -2000 V to 0 V. Remark: The performance of the stage bias will be stated in the tender document, if applicable. Rationale: A stage voltage bias can improve imaging resolution and quality in certain demanding situations. Awarding of points for preference R-1000-081a: Binary (yes or no). No is 0 points; Yes is 100 points. New text for preference R-1000-081b: The SEM should be equipped with a positive stage bias with a tuneable range between at least 0 V to +250 V. Remark: The performance of the stage bias will be stated in the tender document, if applicable. Rationale: A positive stage voltage bias can improve signal to noise ratio as well as filter out imaging artefacts in certain situations. Furthermore it could be used for charge filtering. Awarding of points for preference R-1000-081b: Binary (yes or no). No is 0 points; Yes is 100 points. As a result of this change, TNO has updated Appendix B06 accordingly and made it available via TenderNed. When submitting your bid, you should use this latest version.
11	8.3 - Aspect "SEM imaging" - 32	R-1000-085. What is meant with Pixel integration? What would the advantage be compared to line or frame integration?	This is a mistake, pixel integration should be ignored. The requirement should state: 'line- and frame-integration options'.
12	8.4 - Aspect "Materials analysis" - 37	There is a very big difference between analytical performance with different models in the market. Not all FE-SEMs are able to provide high currents and high resolution at low voltage, in order to do EDX on small details, like the 10nm particles that re described in D003. We would recommend to request and award score to a certain resolution specification at a high probe current (~20nA) and low voltage (~2kV)	We understand that performing EDX analysis on particles as small as 10 nm has a lot of limitations. D003 states indeed that particle sizes are in the order of 10 nm to 10 µm and that EDX analysis on particles may be required. The goal of the statement regarding EDX analysis is that quick switching between imaging an analysis is highly preferred and that EDX has to be done on a selection of (suitable) particles. D003 states the samples which will be used in the SEM, together with context of the use of the samples. Some values in the appendices should not be read as requirements. Performance demands are stated in requirements.
13	8 - Minimum requirements with regard	Will a live on-site demonstration be part of the evaluation procedure?	No
14	8.5 - Aspect "Sample's and sample mea	R-3000-035 - How this preference is evaluated seems to be missing in document D004	Indeed, it is incorrectly stated that the evaluation is as per Schedule D004. The awarding of points: 0 points for maximum tilt angle below 60 degrees. 50 points for a maximum tilt angle of 60 degrees or higher.
15	8.6 - Aspect "Vacuum system and vacu	We have performed the contamination growth test and witnessed no growth of C during 30 minutes. However the carbon concentration measured was always about 4 mass% and 9 at%. Plasma cleaning was performed prior to the measurement. We would request these carbon concentration to be accepted.	Since contamination is an important aspect for us, we cannot simply accept these results. We performed the test at TNO using our previous SEM with a (non-cleaned) silicon wafer. This resulted in ~3 at% of carbon at the end of the test. Using a cleaned wafer should result in much less carbon.
16	8.5 - Aspect "Sample's and sample mea	R-3000-076 In order to share drawings an NDA has to be signed. What we could provide are images. Is that acceptable?	When submitting a bid, a description with image is sufficient. However, the Tenderer to whom the contract is awarded must submit a detailed 2D and STEP file. If necessary, TNO will provide an NDA for this purpose.
17		Requirement 1000-015 Source lifetime demand The question mentions a source replacement, but also tip replacement. What is the difference between the source and the tip in this respect?	Definition of full replacement of source: Replacement of all parts which play a role in emitting electrons and subsequently shaping, focusing and accelerating these electrons in the source column towards the target sample. Tip maintenance or exchange: Maintenance or replacement of the sem tip, which is defined to be the electron emitter part of the source (cathode).
18	9 - Appendices - 66	AppendixD001, "Imaging quality of SEM" Beam current Max.beam current50nA or higher. Taking into account the presented customer samples that will be the scope of use of the SEM instrument, and taking into account that the customer will also use the SEM for the high-sensitivity EDS analysis (hence requiring a highly sensitive EDS detector whose area is not less than 60 mm2), the today's state of development of FE-SEM (field emission SEM) & EDS technology and their vast application experience suggests that the maximum required beam currents for both high-resolution analysis and high-speed analysis do not exceed 5-15 nA. This is also confirmed by the leading EDS manufacturers. In light of such an observation, would it be acceptable to supply the FE-SEM system with maximum beam current of 20nA or higher in order to maximize the system resolution and sensitivity without compromising throughput?	We will likely also perform imaging and analysis on samples other than stated in the appendix. Therefore, we require a flexible SEM system where settings can be adjusted with a reasonably large range. Given the maximum beam current of most state of the art SEM systems on the market, we chose 50 nA as a minimum for the maximum beam current. Therefore, a system with a maximum beam current of 20 nA does not fit our requirements.
19	8.3 - Aspect "SEM imaging" - 32	R1000-010 For the request to provide the resolution at 15 kV in low vacuum, can alternatively the resolution at 30kV in low vacuum be submitted?	Yes, it is allowed to submit the resolution of the system at 30 kV in low vacuum instead of at 15 kV in low vacuum. However, during SAT we do expect that the system will meet the resolution requirement at 15 kV in low vacuum.
20	8.8 - Aspect "Control software" - 51	R6000-155 SEM images store all these required parameters in the TIFF header. Both 8 bit and 16 bit Actually they contain much more parameters (hundreds of them). But it may not conform to the exact EXIF standard. Is it necessary to have the metadata stored specifically in EXIF format?	The idea behind the requirement is that from an image file we can obtain all important parameters, such as beam voltage, detector used, stage coordinates, etc. This can be done by saving the image as TIFF file with Exif metadata. However, if all these parameters are stored in the TIFF header without conforming to the EXIF standard, this is also accepted. Baseline is that we can make a script (for example a Python script) which can extract this information from the file in a predictive way.
21	8.9 - Aspect "Generic requirements" - 58	R0000-055 All the relevant connectivity schemes are well described within the Installation Requirements document and/or Instructions Manual. A drawing of the mechanical interface for the sample holders will be provided. However, drawings of the equipment (in step file format) are intellectual property, and thus cannot be shared. Would this be acceptable?	When submitting a bid, a description with image is sufficient. However, the Tenderer to whom the contract is awarded must submit a detailed 2D and STEP file. If necessary, TNO will provide an NDA for this purpose.
22	8.9 - Aspect "Generic requirements" - 58	R0000-118 Could you elaborate on the required functionality of the mentioned "single-photon detector"?	Mistakenly, R0000-118 refers to "single-photon detector", and for the avoidance of doubt, requirement R-0000-118, remark 2 should be read as follows: please note, that approving the CDR this does not mean that TNO will take final responsibility if during SAT it is found that the system does not meet the minimum requirements. TNO will at all times hold Tenderer ultimately responsible for delivering a scanning electron microscope in accordance with the requirements as stated in this Tender.

23	8.3 - Aspect "SEM imaging" - 32	R1000-081 As the majority of manufacturers provide only negative values for the stage bias and such values go to well above 1kV in order to have effect on the maximum achievable resolution (although at the expense of sample size and also with incapability of distortion-free imaging of tilted samples), what is the rationale to request such a short stage bias range and what is the rationale to request the positive bias values? (The positive values usually are not used to improve resolution. Small positive bias is applied for specimen current monitor to implement touch alarm, and the touch alarm is standard in the SEM configuration).	Since we realize that both positive bias and negative bias give benefits, we will change the points count of this preference to award points for a negative stage bias such as 0 to -2000 V, and we will also award points for a positive stage bias, such as 0 to +250 V. A positive bias could be used for example to deflect secondary electrons back to the sample/stage, resulting in less artefacts and an increase of contrast in backscatter electron detectors. The original preference R-1000-081 will be split up in two preferences, R-1000-081a and R-1000-081b: New text for preference R-1000-081a: The SEM should be equipped with a negative stage bias with a tuneable range between at least -2000 V to 0 V. Remark: The performance of the stage bias will be stated in the tender document, if applicable. Rationale: A stage voltage bias can improve imaging resolution and quality in certain demanding situations. Awarding of points for preference R-1000-081a: Binary (yes or no). No is 0 points; Yes is 100 points. New text for preference R-1000-081b: The SEM should be equipped with a positive stage bias with a tuneable range between at least 0 V to +250 V. Remark: The performance of the stage bias will be stated in the tender document, if applicable. Rationale: A positive stage voltage bias can improve signal to noise ratio as well as filter out imaging artefacts in certain situations. Furthermore it could be used for charge filtering. Awarding of points for preference R-1000-081b: Binary (yes or no). No is 0 points; Yes is 100 points.
24	8.3 - Aspect "SEM imaging" - 32	R1000-015 Source lifetime demand. The question mentions a source replacement, but also tip replacement. What is the difference between the source and the tip in this respect?	Definition of full replacement of source: Replacement of all parts which play a role in emitting electrons and subsequently shaping, focusing and accelerating these electrons in the source column towards the target sample. Tip maintenance or exchange: Maintenance or replacement of the sem tip, which is defined to be the electron emitter part of the source (cathode).
25	5.2 - Evaluation of Eligibility Requirements - 23	Requirement demonstrating / analysing. Some of the requirements state to demonstrate or analyse it. Will there be a demonstration moment in the tender for this? Analysis: will this analysis also take place during the demonstration?	In Chapter 8, but also in Annex D000, the last column of each requirement/preference lists the applicable verification method (VM), which TNO uses to verify whether the Supplier to whom TNO awards the contract, meets the specified and agreed requirements. In other words, both "demonstration" and "analysis" refer here to the verification method, applicable after contract award.