

3rd Review of MAX IV's Project Management

Report by Appointed Review Committee to the
Swedish Research Council, November 2019

PREFACE

The Swedish Research Council (Vetenskapsrådet) is a governmental agency with the responsibility to support basic research of the highest scientific quality in all academic disciplines. It is also part of the agency's remit to evaluate research it funds and to assess its academic quality and impact. The Council for Research Infrastructure (RFI) at the Swedish Research Council has the overall responsibility to ensure that Swedish scientists have access to research infrastructures of the highest quality. Specifically, RFI assesses the needs for research infrastructures in a regularly updated roadmap (where a new version was published in 2018), launches calls and evaluates applications, participates in international collaborations and works on monitoring and assessments. MAX IV is a synchrotron facility under construction and partial operation in Lund, Sweden, for which the Swedish Research Council/RFI is the largest funder. The new laboratory builds on the success of its predecessor MAX-lab, in particular regarding to the MAX-lab innovative accelerator physics and a strong soft X-ray researcher community.

This is the third review conducted since the summer of 2018, primarily focusing on the project management structure within MAX IV. The expert members of the review committee consisted of Thomas Allard, Wolfgang Drube, Carlo Bocchetta, Zahid Hussain, Britt Hedman, Lennart Bergström and Bettina Kuske – the Terms of Reference issued to the committee is attached as Appendix 1. The previous two reviews exclusively focused on issues relating to the beamline program. In this review the enlarged committee has evaluated more broadly the project management as a whole within the facility, also including the accelerator program. Furthermore, we have asked the committee to investigate how MAX IV is handling the transition from the construction phase into the operation phase.

Many of MAX IV's beamlines are now quickly moving into commissioning and in most cases operation. We are delighted to learn that the committee concludes that significant progress can be identified regarding both the project management system, as well as in the development of the beamlines, since the last review held in February 2019. We are convinced that the project is now moving in the right direction. We would like to take the opportunity to thank the review committee for their tireless and excellent work, which has resulted in this report. Furthermore, the efforts of the management and staff of MAX IV is highly appreciated, both for preparing background material for the review and being available for presentations, discussions and in-depth interviews.

Stockholm, November 2019



Lars Kloo, Chair of review
*Secretary General for Council for
Natural and Engineering Sciences (NT)*

Stockholm, November 2019

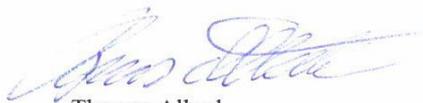


Björn Halleröd, Vice-chair of review
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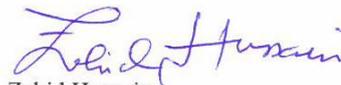
TO THE SWEDISH RESEARCH COUNCIL

The present document presents the views and assessments of the Review Committee members. By signing they take full responsibility for the report. The Chair and his supporting staff confirms that the work was conducted in accordance with the statutes of the Swedish Research Council and that it was performed in an impartial manner.

Lund, November 2019



Thomas Allard
Chair of Sub-Committee 1



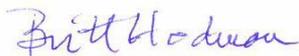
Zahid Hussain
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Wolfgang Drube
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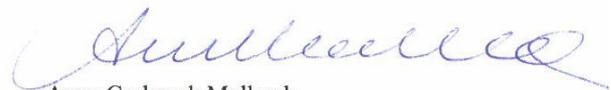
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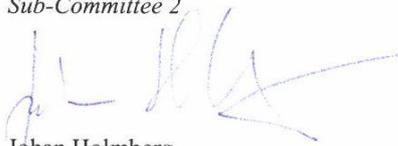
Bettina Kuske
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Niklas Ottosson
Secretary



Lars Kloo
Chair of review



Björn Halleröd
Vice-chair of review

EXECUTIVE SUMMARY

The committee congratulates the MAX IV team on the progress made in the accelerator system, the steady development of the beamlines with baseline functionalities and the increased flow of positive energy and the high morale of the staff devoted to finalising the projects. The committee gained the impression that all problems that led to this series of reviews have been understood and efforts are made by the MAX IV staff to make continuous progress without further delays. The committee furthermore welcomes the appointment of the permanent director, Ian McNulty, and looks forward to seeing that the physical science director position is also filled by a permanent hire in a timely manner.

The scheduling methodology employed at MAX IV and developed by the new CPO-office is sound. The overall timelines for present beamline projects are found to be credible, with the caveat that the extra funding required for future operations is made available. The committee was impressed by the high performance of the accelerators and storage rings, the outreach actions of the user office and the effort to bring more beamlines into operation as soon as possible. The MAX IV team can take pride for the high demand of the facility as judged by the large amount of user proposals submitted for the last calls. The high cut-off score is also an indicator showing that the demand for beamtime at MAX IV is at par with other world-leading synchrotron radiation facilities.

There are however some areas of concern relating to the transition to full operation. MAX IV should develop a strategy and vision of how full user operation can be efficiently organised and how full support to the users can be provided. This may include the establishment of a group of floor coordinators, the grouping of services/maintenance for similar beamlines and adequate beamline commissioning shifts for making sure that the beamlines along with associated end-stations are user-friendly and capable of carrying out impactful science.

In order to become an efficient organisation for further development of beamlines, and at the same time support operation, it is essential that the MAX IV management carry on the positive work with implementing a matrix organisation with the most effective project management connected to a proactive financial department and make use of its risk assessment method.

For establishing MAX IV as one of the leading user facilities in the world, it is seen as essential to reach out and aggressively engage the relevant leading scientists, primarily in Sweden, to effectively help the facility to develop and utilise its capabilities. This will also help to demonstrate MAX IV's applications for world-leading experiments that best utilise the unique properties of the pioneering suite of accelerators. The committee is aware of the strength of the Swedish X-ray community and would like to see MAX IV's management making further efforts in seeking its involvement. In the end, this will be essential for capitalising on the large Swedish investments and the successful innovations of the multi-bend achromat lattice for storage rings that many other synchrotron radiation facilities are now copying and further developing. In the recommendations section at the end of the report, the committee suggests a number of specific action items in this direction.

Overall, the committee is happy to see that MAX IV is finally on the trajectory in insuring its position and displaying its potential in becoming a world-leading synchrotron radiation user facility.

REPORT FROM REVIEW COMMITTEE

Introduction

In preparing for and executing the review of MAX IV the committee has followed the structure of the Terms of Reference issued by the Swedish Research Council (given here as Appendix 1). The following report is divided into the various headings in the terms of reference, grouping the charge questions in 4 categories: Scope, Cost and Schedule, Technical, and Management. Under each of these sections we state findings and give comments that relate to the respective charge questions. In the following section 5, we give some specific comments related to the challenges MAX IV has and will be facing as the facility transitions into operations. In section 6, we give comments on the progress on the 9 recommendations given in the previous review report from February 2019. Finally, in section 7, we give a number of new recommendations – these mainly cluster around the topics defined by the Charge Questions in the Terms of Reference, but also go beyond as the committee identified a number of issues that it advises MAX IV to quickly act on. Each of the recommendations are given with a due date, upon which the committee recommends that the Swedish Research Council follows up, both through continued reviews but also in other formats.

1. Scope

1.1 Findings

Highlights were presented to the committee for all three parts of the MAX IV accelerator complex, the 1.5 GeV (R1) and 3 GeV (R3) rings as well as the 3 GeV linac. For the linac, a demonstration of 16 fs rms bunches using a single (out of two) bunch compressors (bunch charge was not mentioned) has been achieved. For the R1 ring, a 500 mA current in multi-bunch and 93 mA in single bunch-filling was demonstrated. For the R3 ring, an extraordinary passive stability of the orbit was shown as well as a world-leading orbit stability during top-up injection. With few exceptions, the design parameters of all the three machines have been archived or even surpassed. The delivery of the design current in R3 of 500 mA has been demonstrated in the machine shift under optimised conditions. A future permanent operation at 500 mA, if and when needed, will depend on an increase of available RF power; this project is in the planning phase. Also in R1 500, mA has been demonstrated and regular operation at high current is an option, it is however debated between the different beamlines whether there is a strong need for this high ring current.

The most complicated limitation of the linac is the 2 Hz operation frequency. The planned increase to 10Hz will affect the complete accelerator complex, and before pursuing this MAX IV needs to await approval from SSM (Strålsäkerhetsmyndigheten, the Swedish radiation safety agency). This risks delaying the FemtoMAX operation at repetition rates meaningful to users by several months.

Problems were reported on small, but still disturbing (due to the small spot size) shifts of the beam position during undulator gap changes. This will be handled by the fast orbit feedback system under development. The increasing (and sufficient) amount of delivered beam time in 2019 is a good indicator that all accelerator components are running reliably.

Among the 16 funded beamlines, 7 beamlines are operational with baseline capabilities, 4 beamlines are under commissioning. Furthermore, FemtoMAX is operational with 2Hz repetition rate which is considered too low for a regular user program. Key Performance Parameters (KPP) have been defined for 4 beamlines that are under development and it is understood from the Director's talk that all future beamlines will have well-defined and agreed-upon KPPs.

All operational beamlines are delivering beam time to users who have been selected through the proposal review process. The demand for beamtime is quite high. The HIPPIE beamline (ambient pressure XPS beamline) has the highest demand, whereas BioMAX (structural biology) meets all needs of the users with effective utilisation of beam time, improved efficiency and the high performance of the beamline.

Most of the beamlines on the 1.5 GeV-ring were transferred from MAX-lab, and are developed to meet the needs of the existing user base. The beamlines on the 1.5 GeV-ring are primarily soft X-ray beamlines that largely carry out experiments along similar lines as were previously done at MAX-lab. The newly constructed beamlines are state-of-the-art and making good use primarily of the high brightness delivered by the MAX IV accelerators. Some of these beamlines, such as NanoMAX and CoSAXS, are utilising and/or have the potential to gain significantly from the high coherent power delivered by the MAX IV storage rings.

1.2 Comments

The scope is well defined and the committee commends the effort of the accelerator team in delivering outstanding performance and world-leading results. The accelerator projects under execution will further consolidate the performances of all three machines. Two projects in the planning phase, i.e. the RF power plant expansion in the 3 GeV Ring and the cooling system improvements in the linac and transfer line to the 1.5 GeV ring are conceived of lower priority, also by the committee. We appreciate the existence of the “Accelerator Division Project Portfolio Process” to lay out a clear process for further machine developments.

The baseline parameters and full scope of the 16 beamlines have been defined and can be tracked. Since the last review, there has been no significant change in the scope of the existing beamlines. A large fraction of the 16 beamlines completed or near completion are state-of-the-art and capable of performing at the research frontier and delivering impactful science. The facility, however, needs to take an aggressive approach in setting the priority, after the completion of the baseline, to pay attention to experimental capabilities that are capable of tackling grand challenges by making the best use of the MAX IV performance parameters. Imaging using NanoMAX, *in-situ/operando* science using APXPS at HIPPIE and high-resolution *in-situ* RIXS at VERITAS are some of the current applications that are benefitting from the unique MAX IV characteristics.

Another great opportunity lies in dynamical time-resolved studies with the use of XPCS. The committee was delighted to hear that during the 2019 User Meeting, a workshop with a focus on XPCS took place that brought many interested scientists together. One of the committee members took part in this workshop and we heard the event was very successful with many enthusiastic participants. It is important that MAX IV now takes the lead through the engagement of the interested scientists to develop a strategy for delivering XPCS experimental capabilities as soon as possible for both hard x-rays (e.g. CoSAXS, which has started commissioning, provides an early opportunity for hard x-ray XPCS) as well as soft x-rays. It is worthwhile to point out that the time resolution achieved in an XPCS experiment is improved as the square of coherent power. Thus, a gain of 100 times in coherent power will lead to 10,000 times increase of timing resolution for an XPCS experiment. Since the coherent power is proportional to the square of wavelength, the soft x-ray regime provides higher sensitivity where additional gains may be achieved through utilisation of resonance effects. This allows for site-sensitivity for excitation at transition-metals absorption edges, e.g. Mn, Fe, and Cu, that are important elements for high-temperature superconductivity, photosynthesis process, and catalytic functions to name a few. Therefore, MAX IV now has the potential to become the world leader in XPCS before other facilities, which currently are going through upgrades, become operational.

2. Cost and Schedule

2.1 Findings

Overall, MAX IV has presented a credible budget. However, according to this budget the secured funding for future operation is, as of today, insufficient, which will result in a net deficit already next year. As a result, the current level of funding is not adequate to deliver the defined scope, e.g. the number of planned hours of beamtime delivery with the intended level of staffing etc.

Currently, the financial system is not fully connected to the project management system, something which the previous reviews also have pointed out. While the awareness of these issues is now much greater than previously, and various aspects are mitigated manually, it is still the case that the exact cost of the full

construction of a beamline at MAX IV, including the required staffing resources that are partly financed through the operations funds, cannot be fully monitored.

The scheduling methodology employed at MAX IV and developed by the new CPO-office is sound. We therefore consider the timelines for present beamline projects credible, with the caveat that the extra funding required is made available.

2.2 Comments

The largest concern for the committee is the current significant lack of funding for full future operations. It is our understanding that, unless additional funding is allocated MAX IV, will not be able to deliver the intended scope. It is therefore crucial that MAX IV urgently presents a risk analysis and communicate the consequences of various scenarios to funders, users and other relevant stakeholders.

In the interviews, it was found that the funding for the various projects only covered the cost of procurement. The labour costs are, however, largely covered with operational funds. In the future, when estimating a project, all costs must be covered with realistic cost estimates and allow for a correct acknowledgement of the funding sources for the various projects.

The financial department of MAX IV uses a financial system that is inherited from Lund's University and we understand that it is not possible to change that. The reporting of spending in the projects is done in a manual way using electronic spreadsheets. This should be sufficient also for the future even though it puts a heavier burden on the financial department.

3. Technical

3.1 Findings

Full attention is being paid to track technical progress and to proceed with the procurements and fabrication needed to complete the beamline and experimental projects.

For many beamlines, a systematic effort is made to properly analyse commissioning results and take needed actions as required. However, for several beamlines the review committee could not tell if they are also following similar practices.

With regard to project risks, these are generally well-considered, but they are not used in any mitigation plan and no contingency is allocated towards the risks.

3.2 Comments

Generally, the procedure for tracking technical progress around projects is now rather good, but further refinements of the process may help to streamline the efficient completion of the beamlines and experimental projects in a timely manner and within budget.

A uniform and clear policy may be adopted for the commissioning of all remaining beamlines, e.g. a web-based system for internally tracking and communicating the commissioning results, could be beneficial for MAX IV.

As mentioned above, MAX IV generally has a good strategy for identifying risks but the full risk assessment method is not being used for mitigation of those risks.

4. Management

4.1 Findings

The committee is pleased to find that the current management team itself has the needed expertise to successfully execute the various projects at the MAX IV facility. Nevertheless, it is clear that some technical expertise functions within the organisation are understaffed (e.g. safety, automation) and the committee sense that the organisation is too lean in several areas.

The management has made big progress in adapting to a matrix/project organisation during the last year. However, there are still steps to take, amongst these is the need to connect the financial system to the work-breakdown structure (WBS). As a result, the committee is confident that there now is sufficient tracking of

the projects and that the overall construction and installation schedule is sufficiently detailed to understand critical paths.

Major efforts have been made to clearly present the capabilities of the beamlines at the current stage. Significant efforts have also been made to reach out to the user community.

4.2 Comments

Given the lean staffing situation, it is crucial to use a risk assessment process to identify the needed expertise, in quality and quantity, during the various periods of the projects. The project managers should keep track of that and report to the CPO, so that appropriate actions can be taken when needed.

We see a lack of toll gate planning in the projects which means that progress is not accurately known when different steps are to be fulfilled. Consequently, neither the project managers nor the financial department knows sufficiently well whether the project is progressing according to the scope and timing of the plan. A holistic planning for project completion and facility operation needs to be done to maximise the utilisation of resources.

Due to the problematic past, the perception of MAX IV as a severely delayed facility is ingrained in the Swedish user community. The committee considers this a major concern that requires mitigation at numerous levels. The need to reconnect with the user community and show that MAX IV is now indeed becoming an operating facility that can serve a multitude of users with different scientific interests cannot be underestimated.

5. Comments on MAX IV's transition to operation

The development, build-up and commissioning of the beamlines at MAX IV is organised in distinct scientific beamline groups and it has been pointed out to the committee, that there is good communication between groups with related beamline projects. It was also communicated that full 24/7 operation is running, that an on-call system is established, that there are flex-time agreements with beamline staff and that floor-coordinators are considered for 2021.

Despite all these positive developments, full user operation and successful user support might need a change in the work organisation at MAX IV. Standardisation and ease of maintenance, compatibility of software and the establishment of systems to share knowledge on difficulties or malfunctioning systems encountered in different beamlines will be of growing importance, as well as an open system for the users to track the fixing of problems and other status information. On-call staff must be able to deal with all beamlines and should not be limited to knowledge of singular systems.

The committee is under the impression that MAX IV is currently not fully considering these emerging tasks at a sufficient level of detail. We want to point out that thoughtfully preparing for the operational aspects early enough in the setup of the user facility will save double work later and will reduce the number of staff required in user support at a later stage.

6. Progress on previous recommendations

In the previous project review report of February 2019 the review committee gave 9 recommendations. These are listed below together with comments provided by the committee on how they have been addressed:

- 1) MAX IV should formalise a procedure for clearly and consistently defining the baseline ("day one") capabilities of each beamline going into operation, which need to be shared with the stakeholders and communicated to the user community. The timeline for the completion of the beamlines to the full specifications should further be defined.*

We note significant progress in this area. Baseline capability has been defined but we still observe uncertainties regarding the timelines for reaching full specifications of the beamlines.

2) *We recognise that the acting director holds a two-folded portfolio in his hands. Because of the urgency in completing the delayed beamlines the scientific management has been more occupied with organisational and project development and therefore could focus less on establishing the scientific program. However, it is essential that the MAX IV management now pays full attention to the scientific program as this will be crucial for the future success of the facility.*

This is under way but needs further attention, see new recommendations.

3) *The review committee has been informed that the MAX IV board has appointed a search committee and opened up the position for a permanent director of MAX IV. The committee strongly urges the board to expedite this process as this is delaying the establishment of the scientific program of MAX IV.*

MAX IV has implemented this recommendation and the committee welcomes the permanent director, Ian McNulty.

4) *MAX IV needs to develop a visionary scientific strategic plan which makes the best use of the coherence of the beams delivered by the pioneering MAX IV accelerators. The time-window of opportunity is narrow and there is an urgency to add experimental capabilities that fully utilise this coherence. This should be done with full engagement of the MAX IV user community, e.g. through dedicated workshops or individual interactions.*

Not yet done, see new recommendations for specific comments.

5) *We encourage MAX IV to further improve the proposed scheme for dealing with the matrix organisation in the project management in order to make the whole organisation aware of how the projects are managed.*

MAX IV has already taken several steps in this direction and we encourage the organisation to continue this work.

6) *The board of MAX IV should take a more active role in communication with the laboratory's management in setting up the new project organisation and finally approve a new model.*

We are pleased to note that the board has been more active in communicating and supporting management.

7) *The head of the newly established Project Office should be part of the management team.*

MAX IV has implemented this recommendation.

8) *A communication officer ought to be closely associated with the management team in order to facilitate effective communication, both internally and externally.*

MAX IV has implemented this recommendation.

9) *MAX IV should look for best practices for a more efficient development of relevant software/control systems as it still is a bottleneck in the completion of projects.*

Progress has been made but this is still under development. The communication between KITS and the beamlines staff has to be further improved.

7. Recommendations

To conclude this report, the review committee would like to give the following ten new recommendations, the order of which does not reflect any intended prioritisation:

1. Management should communicate the consequences if the current funding is not adjusted to meet the calculated and reviewed budget needs. The consequence analysis should be presented to relevant stakeholders by the end of 2019.
2. A toll gate system should be established to approve and track the spending in all projects. The financial department together with the CPO should be responsible for this system. The system should be implemented for new projects. (Q1 2020)
3. The existing risk assessment method should be continued and further developed. For the new projects, associate the risks with costs, scope and schedule. (Q2 2020)
4. Further develop and apply the current matrix project structure to the MAX IV organisation. A system for resource loaded schedules with tracking of costs should be implemented for all new projects. (Q3 2020)
5. Develop a clear risk mitigation against staffing single point failures. Roles and responsibilities for the different functions within MAX IV needs to be documented. For key staff this should be implemented by Q2 2020.
6. Utilise the director discretionary time to engage with prominent scientists who could explore the science capability of the existing beamlines and demonstrate the potential of using MAX IV for impactful science. (starting Q1 2020)
7. Develop the science case for future beamlines to fully utilise the unique capabilities of MAX IV by engaging experienced and emerging scientists at Swedish universities as well as international institutions who may help to organise workshops on topics of grand scientific challenges. (Q1 2021)
8. Hire an expert scientist to lead the development of XPCS experimental capabilities that could best utilise the high coherent power of x-rays provided by MAX IV. XPCS at MAX IV offers a unique scientific opportunity for the study of dynamics at time scales that have not been previously possible. (Q2 2020)
9. Develop prioritisation for full-scope completion of existing/funded beamlines that make best use of the unique characteristics of MAX IV. (Q2 2020)
10. Further evolve the strategy/vision for an efficient organisation of beamline operation and user support to enable outstanding science. (Q4 2020)

APPENDIX 1: TERMS OF REFERENCE

Background

During the summer of 2018 an audit team, on the request of the Council for Research Infrastructures (RFI) within the Swedish Research Council, reviewed the project management structure at MAX IV relating to the construction of the beamline park. The report revealed deficiencies in the project management methodology which, in part, was seen as the reason for the delay in the deployment of some of the beamlines. This review was followed-up from a similar perspective in February of 2019. It was found that great progress had been made but that significant work still remained to be done before the problems that were identified in 2018 will be completely rectified.

Purpose, method and scope

Beginning with a review in November of 2019, RFI will now start an annual review cycle of MAX IV in order to ensure that the funding from the Swedish Research Council (presently 310 MSEK/year) is being used in an optimal way. The purpose of these reviews is two-fold: Firstly, the Swedish Research Council and other stakeholders need to monitor how MAX IV is progressing toward operations and how the recommendations from the previous review are being implemented. Secondly, MAX IV should be given principle advice on how to deal with any potential problems identified during the review.

The review committee's focus should be on whether the organisation employs the right methodology to deliver the planned scope required for the intended user science cases. In order to do so the review team will be divided into two sub-committees, where each of the two sub-committees will be headed by a respective sub-committee chair person:

- 1) **Project Management (Chair: T. Allard):** This sub-committee will focus on the project management methodology employed to execute various projects at MAX IV, both relating to beamlines and accelerators. The group should focus on how the methodology might be further improved to deliver the projects according to planned scope, cost, and schedule.
- 2) **Transition to operations (Chair: Z. Hussain):** This sub-committee will focus on how the various projects are being practically and technically implemented in relation to the planned scope and the scientific needs of the MAX IV user community. The sub-committee may comment on options on technical solutions within the intended scope but should not make recommendations that are in conflict with the plans described in funded applications. However, the sub-committee may suggest future scientifically impactful ways forward beyond the currently defined scopes.

The review will be conducted on 11-12th of November of 2019, as agreed with the management of MAX IV. The background material will consist of a document package that MAX IV will be submitting upon the detailed request of the Swedish Research Council – this request will be sent no later than 4 weeks prior to the start of the review. The material will then be sent to the group when available, but no later than one (1) full week before the start of the review.

The bulk of the work will be done at MAX IV and will be based on 1) plenary session which are jointly held for the whole review committee, 2) breakout sessions for the respective subcommittee and 3) interviews with individual people within the organisation as the review committee sees fit. The main findings and the recommendations of each subcommittee will be presented at a concluding closeout session in the end of the second day. The findings of the committee should further be formulated in a brief report to the Swedish Research Council, addressing the questions listed below, and be finished no later than two weeks after the review has been concluded. A detailed instruction of the desired format of the report will be provided by the Swedish Research Council to the reviewers before the review.

Charge questions

The following questions should be answered by the subcommittees from their respective perspectives:

1) **Scope:**

- a. Is the scope of accelerator projects, beamlines and experimental capabilities well defined and tracked appropriately using defined practices?
- b. Are there any changes in scope (enhancement or reduction) since these were baselined?
- c. Is the current scope suitable to deliver an impactful user science program at MAX IV?

2) **Cost and Schedule:**

- a. Are the cost and schedule estimates complete, credible, and of sufficient quality to execute current beamline and accelerator projects within MAX IV?
- b. Are the cost and schedule estimates adequate to deliver the defined scope?
- c. Are the financial systems and staff properly collecting and reporting the project progress, schedule, costs, and earned value?
- d. How reliable is the current timeline given the present project management structure?

3) **Technical:**

- a. Is the technical progress to date sufficient to support the proposed procurements and fabrication as planned?
- b. Are the beamline commissioning results properly analysed and are the appropriate following actions taken?
- c. Are project risks being appropriately identified and managed?

4) **Management:**

- a. Does the current management team possess the expertise and have the needed technical staff to successfully complete and deliver the defined scope.
- b. Are projects at MAX IV being managed for successful execution and for transition from build-up to user operations?
- c. Do the various projects have the necessary resources?
- d. Is the project leadership and team fully staffed with people who have sufficient expertise and experience to successfully execute the project and progress at the current stage?
- e. Is the overall construction and installation schedule detailed at a sufficient level to understand critical paths?
- f. Are the capabilities and status of the beamlines sufficiently communicated to the user base and are the needs of that user base sufficiently known and considered by the facility, both for current beamlines and for future developments?

5) **Recommendations:** Have the recommendations from past reviews been appropriately addressed?

APPENDIX 2: SOURCES OF INFORMATION

The conclusions drawn in this report were based on three main sources of information, namely; i) a set of documents provided by MAX IV beforehand to the review committee, ii) presentations given by the laboratory management and staff with following discussions together with the review committee, and iii) interviews with a number of critical persons in the laboratory staff. The list of interviewees, which was compiled based on the request of the reviewers, is given below:

- Ian McNulty, Director
- Marinanne Sommarin, Chair of MAX IV Board
- Karina Thånell, Beamline Scientist & Project Manager of SoftiMAX
- Darren Spruce, Head of Controls & IT
- Mugeni Nuamu, Head of CPO
- Marie Andersson, Head of Finance and Office Services
- Conny Sâthe, Interim Physical Sciences Director
- Ann Terry, Group Manager for Diffraction and Scattering
- Franz Hennies, Head of User Office
- Andrey Shavorskiy, Beamline Manager of HIPPIE