Risk Assessment Document

(HPHV) Steam Heat Sterilizer

Equipment/System ID: ……..

Revision index

Revision	Date	Reason for revision
00		First Issue

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1.0 Approval:

This document is prepared by the Validation team of ……... for the project "Oral Solid Dosages Formulations Facility" of ……. under the authority of their Project Manager. Hence this document before being effective shall be approved by the Head QA of ……...

PREPARED BY		
NAME/ FUNCTIONAL AREA	**SIGNATURE**	**DATE**
Validation & QA		

CHECKED BY		
NAME/ FUNCTIONAL AREA	**SIGNATURE**	**DATE**
Validation & QA		
Quality Control		
Engineering		
Quality Assurance		

APPROVED BY		
NAME/ FUNCTIONAL AREA	**SIGNATURE**	**DATE**
Head -Quality Assurance		

2.0 INTRODUCTION:

According to the definition, given in Annex 15, 20 of the EU-GMP-Guide and ICH Q9, a risk assessment is a method to assess and characterize the critical parameters in the functionality of an equipment or process. Therefore, risk assessment is a key element in the qualification and validation approach.

In the project context, risk analyses are performed as basic GMP/EHS-Risk assessment, which shall help to identify important GMP/EHS-requirements.

3.0 AIM OF THE RISK ANALYSIS:

At the very basic stage of design the risk assessment is to verify that all features are taken into consideration to avoid the risk of failure of critical GMP and EHS parameter in the equipment.

During study all GMP and EHS parameters will be identified and assessed for the risk if not considered in the design or requirements.

The Risk assessment report is produced to provide the documented evidence that design concepts or requirement are complete in considering all GMP and EHS risks.

4.0 REFERENCE DOCUMENTS:

S.No.	Document Title	Document Number
1.	Validation master plan	..……..
2.	Project validation plan	……

5.0 SYSTEM DESCRIPTION:

This risk analysis is conducted for an Steam Heat sterilizer for QC consisting of the following main components:

- Sterilization chamber
- Connections for clean media piping
- Vacuum system
- Heating and cooling system
- Control System
- Instrumentation / equipment for process control, monitoring and recording

The unit shall be used for sterilization of Media, Petri plates, glassware, garments as well as other accessories, which are required within the class A/B areas.
The sterilization processes would be facilitated by use of Steam generated by Inbuilt boiler.
Most of the possible risk concerning the handling/ operation of the Steam heat sterilizer has been considered in this RAD.

6.0 PARTICIPANTS:

Name	Function	Signature

7.0 RISK MANAGEMENT PROCESS:

A typical Risk management process consists of following steps:

- Risk Assessment:
  - Risk Identification
  - Risk Analysis
  - Risk Evaluation

- Risk Control
  - Risk Reduction
  - Risk Acceptance

- Result of Risk management processes
- Risk Review

- **Risk Assessment:**
  It consists of the identification of hazards and the analysis and evaluation of risks associated with exposure to those hazards.
  Risk identification is a systematic use of information to identify hazards referring to the risk question or problem description.
  Risk analysis is the estimation of the risk associated with the identified hazards. It is the qualitative or quantitative process of linking the likelihood of occurrence and severity of harm.
  Risk evaluation compares the identified and analyzed risk against given risk criteria. Risk evaluation considers the strength of evidence for all three of the fundamental questions.
  The output of a risk assessment is either a quantitative estimate of risk or a qualitative description of range of risk. In case of qualitative description the risk is expressed using descriptors such as “high”, “medium” or “low”.

- **Risk control:**
  It includes decision making to reduce and/ or accept risks. The purpose of risk control is to reduce the risk to an acceptable level. The amount of effort used of risk control should be proportional to the significance of the risk.
  Risk reduction focuses on processes for mitigation or avoidance of quality risk when it exceeds a specified (acceptable) level. Risk reduction might include actions taken to mitigate the severity and probability of harm.
  Risk acceptance is a decision to accept risk. Risk acceptance can be a formal decision to accept the residual risk or it can be a passive decision in which residual risks are not specified.
- The output/ result of the quality risk management process should be appropriately communicated and documented.
- Risk management should be an ongoing part of the quality management process. A mechanism to review or monitor events should be implemented.
  The output/ results of the risk management process should be reviewed to take into account new knowledge and experience.

This document applies the risk management principles to identify the risks associated with the design, construction and operational features of any equipment, which is going to be procured and installed in the facility.

7.1 IDENTIFYING GMP RISK:

Identification of Risk associated with the equipment, is generally based on prior experience and the concerns of the participants of risk assessment document.
The risks identified are categorized as “GMP risk” or “Non-GMP risk”.
GMP is defined as “the practices which ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use and as required by the marketing authorization.”
Thus, GMP covers all aspects of the manufacturing process: defined manufacturing process; validated critical manufacturing steps; suitable premises, storage, transport; qualified and trained production and quality control personnel; adequate laboratory facilities; approved written procedures and instructions; records to show all steps of defined procedures have been taken; full traceability of a product through batch records and distribution records; and systems for recall and investigation of complaints. Thus those risks which might have a direct or indirect impact on the quality of the product are classified as “GMP risk”.
Also, those risks which might result in regulatory guidelines non-compliance are also classified as “GMP risk”. For example: The MOC of the product contact part has a direct impact on the quality of the product. Thus, it is classified as GMP risk.

The “Non GMP” risks include risks related to EHS, operational and other non-critical hazards.

Following types of risks are mainly identified during risk assessment process:

- Risk related to product contact materials for equipment and containers (eg. Selection of SS grade, gaskets, lubricants etc.)
- Risks related to appropriate utilities and their control (e.g. Steam, gases, power source, compressed air etc.)
- Risks related to calibration/ preventive maintenance
- Risks related to protection the environment and health & safety of personnel.
- Risks related to cleaning & sterilization
- Risks related to control system of the equipment
- Risks related to product loss

7.2 RISK ANALYSIS & EVALUATION:

The risk analysis is performed using a qualitative basis of approach.
Qualitative analysis uses word form or descriptive scales to describe the magnitude of potential consequences/ impact and the likelihood that those consequences will occur.
The qualitative measures of likelihood includes descriptors like “Unlikely”, “Possible” and “Likely”, whereas the qualitative measures of consequence/ impact includes descriptors like “Minor”, “Moderate” and “Major”.

Qualitative measures of likelihood

Level	Descriptor	Example detail description
1	Unlikely	May occur at some time
2	Possible	Might occur at some time
3	Likely	Will probably occur in most circumstances

Qualitative measures of consequence/ impact

Level	Descriptor	Example detail description
1	Minor	• No impact on the product quality or outcome of the equipment. • Features required for easing equipment operation.
2	Moderate	• No direct impact on product quality/ outcome of equipment. However may indirectly affect the product quality. • Minor effect on personnel health • Used in the initial stage of operation, however it may affect the final output but those are not used for final release of output. • Effect on environment such as clean room.
3	Major	• Features having direct impact on product quality/ outcome of equipment like contact parts MOC, Surface finish, Control system, Process air quality etc. • Failure could lead to regulatory non-compliance. • Loss/ damage to equipment or its critical sub-components • Critical instruments not calibrated or not of desired range or accuracy. • Proper supporting documentation not provided. • Major effect on personnel health

Based on the above parameters of likelihood and consequence a qualitative risk analysis matrix is prepared to identify the overall Level of Risk, as mentioned in table below.

Qualitative risk analysis matrix – level of risk

Likelihood	Consequences/ Impact		
	1 – Minor	2 – Moderate	3 – Major
1 (Unlikely)	Low	Low	Medium
2 (Possible)	Low	Medium	High
3 (Likely)	Medium	High	High

The final Risk level shall thus be described using descriptors such as “Low”, “Medium” & “High”, where each descriptor implies the following meaning:

Low Risk can be accepted or ignored. These do not affect the final quality of the equipment/ system and it can be managed by routine procedures and are unlikely to need specific application of resources.

Medium Risk required ongoing monitoring and review, to ensure level of risk does not increase. Otherwise manage by routine procedures.

High Action plans must be developed, with clear assignments of individual responsibilities and timeframes.

8.0 PROCESS FOR RISK ANALYSIS:

In the following section a table is produced for the risk analysis. The significance or instruction for each column is described in the following paragraph.

Column 1:	**Serial number** of Risk analysis item.
Column 2:	**Process step/Component**: Identify the process step or component associated with the risk.
Column 3:	**Risks**: Identify the type of risk associated with the process or component.
Column 4:	Verify that whether risk have **GMP impact.**
Column 5:	**Justification**: Provide justification for declaring both yes/no for GMP Impact in column 3.
Column 6:	For the risk **other than of GMP impact,** write what is the type of risks e.g. EHS, Operational.
Column 7:	**Justification**: Provide justification for considering any risk.
Column 8:	**Risk level** Determine the Risk level as High, Medium or low based on the impact.
Column 9:	**Risk Control:** It is further divided into following three sections.
Column 9a:	**Mitigation Method**: Write the risk mitigation strategy as considered in design.
Column 9b:	**Residual risk level**: After the risk mitigation what is the residual risk level, whether it is acceptable, low or Medium
Column 9c:	**Test Point**: Write the test point where the risk mitigation strategy will be verified.

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								Mitigation Method (9a)	Residual risk level (9b)	Verification (9c)
1.	Size	Equipment is not suitable size	No	NA	Operational	• Due to smaller size no of loads will increase. • Larger size equipment cannot be installed.	Low	Equipment shall be suitable Internal and external sizes.	Acceptable	IQ
2.	Cleaning	Improper cleaning of chamber	Yes	Chance of contamination	No	NA	High	Finishing of chamber shall be smooth and easily cleanable	Acceptable	IQ
3.	Labelling	Labelling of components inappropriate	Yes	Pre-requisite for qualification	No	NA	High	• Unique identity no. / Flow direction must be on components / media, operator panel, etc. (e.g. according to P&ID). • All labelling should be in English language.	Acceptable	IQ
4.	Chamber	Low / No drainability	Yes	Storage of condensate may led to inadequate sterilization	No	NA	High	• Drain should be at deepest point. • Temperature measurement at drain shall be provided.	Acceptable	OQ

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5.	Gasket for Sterilization chamber	Gasket MOC not compatible	Yes	Product to be sterilized will be active with MOC	No	NA	High	• MOC should be of food grade (Silicon/PTFE). • Gasket should be temp resistant up to 200 ºC.	Acceptable	IQ
6.	Sterilization chamber	Leakage in Chamber	Yes	Sterilization process out of specification may lead to contamination.	No	NA	High	Vacuum leak test cycle should be considered in design	Acceptable	OQ
7.	Validation port	No/Insufficient validation ports	Yes	Qualification activity may not be performed properly	No	NA	Medium	Validation port shall be provided for multi point temperature Mapping.	Acceptable	IQ

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8.	Weld joints of Sterilization chamber	Weld quality not adequate	Yes	• Cleaning problems. • May lead to contamination	No	NA	High	Weld joints of chamber should be grinded and polished.	Acceptable	IQ
9.	Sterilization Chamber inclusive doors and connected parts / equipment in direct contact with chamber, piping	Material not suitable	Yes	Interaction with media possible	No	NA	High	• Metal materials: Stainless steel AISI 316 or better material • Non-metallic/ Elastomer parts must have a food grade quality.	Acceptable	IQ

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10.	Sterilization Chamber Pressure	Pressure not maintained	Yes	Inefficient sterilization	No	NA	High	Pressure transmitter along with the signal distributor shall be provided to monitor & record the chamber pressure regularly.	Acceptable	IQ
11.	Jacket for Sterilization Chamber	Increased steam consumption	No	No direct impact on Process	Operational/EHS	Heat consumption increased. Heat transmission to the environment may increase the room temperature.	Medium	The jacket should be provided to increase Heat transfer efficiency & structural strength.	Acceptable	IQ

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12.	Sterilization Chamber inclusive doors and connected parts / equipment in direct contact with chamber, piping	Surface finishing insufficient	Yes	Micro-organisms may accumulate on metallic surfaces	No	NA	High	• Surface roughness of chamber should be Ra ≤ 0.8 µm, proven by certificates. • Surface roughness for pipe welds should be Ra ≤ 1.2 µm • Surface should be Crevice free smooth, rounded corners & smooth. • Pipeline should be mill finished internally.	Acceptable	IQ
13.	Doors seal	Door sealing damage	Yes	Sterilization out of validated procedure..	No	NA	High	• Failure has to be alarmed. • Preventive maintenance of the sealing. • Regular visual check of the sealing.	Acceptable	OQ/ SOP

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14.	Doors position indicator	Door position indicator failure/damage	Yes	• Sterilization out of validated procedure. • Contamination of clean room possible by opening both doors.	No	NA	High	• Regular checks as per defined SOP "Calibration and maintenance". • Provide door Interlocking to prevents opening of both doors and start of sterilization	Acceptable	OQ/ SOP
15.	Doors safety device	Door-safety device fails	No	No influence	EHS	Operating personnel may be at risk.	Medium	• Door-safety device failure alarms shall be available • Door safety device checked before operation.	Acceptable	OQ/ SOP

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16.	Doors interlock	Door interlock does not work	Yes	Contamination of room class A/B.	No	NA	High	• Verification of interlock during qualification. • Should define in SOP 'Operation of the autoclave'. • The provision should be made to start the sterilization process only when the door is interlocked.	Acceptable	OQ/ SOP
17.	Door opening	Door open with the high pressure.	Yes	Door open with the pressure may led to Product to move with the pressure flow.	EHS	Personnel may be at Risk. Environment temperature may get increased.	High	Gasket release valve should be provided & made open before the door is to be opened.	Acceptable	OQ

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18.	Door opening in case of incomplete sterilization /abort	Door at clean side not locked in case of failed sterilization process/ abort	Yes	un sterilised components may transfer to Grade A/B.	No	NA	High	• Door at unloading side(Grade A/B) should not open (locked) in case of sterilization process not completed/ abort / • SOP 'Operation of the steam Heat Sterilizer'.	Acceptable	OQ/ SOP
19.	Valves for clean utilities	Inadequate joints	Yes	Contamination possible	No	NA	High	Hygienic sanitizable valves shall be part of equipment	Acceptable	IQ
20.	Piping for Clean utility	Inclination of piping too low may result Inadequate drain ability	Yes	Risk of contamination / microbial growth in piping possible due to stagnant of water	No	NA	High	• Clean utilities piping should be inclined to the chamber (>1 %). • Direct connection between pipe and drain should be avoided	Acceptable	IQ
21.	Piping for Clean utility	pipelines having dead legs, air pockets	Yes	contamination / microbial growth	No	NA	High	Dead legs, air pockets, should be minimised (preferred <3d)	Acceptable	IQ

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22.	Welding of pipes	Welding Quality not adequate (piping)	Yes	Due to improper welding there might be cleaning problem.	No	NA	High	Pipeline for clean utility shall be orbitally welded.	Acceptable	IQ
23.	MOC of clean utility piping	Material not suitable	Yes	Material not resistant – interaction with media possible	No	NA	High	• Metal materials: Stainless steel AISI 316 or better; material certificates • Non metallic/elastomer parts must have a food grade quality.	Acceptable	IQ
24.	Vacuum break Filters	No filter for fresh air inlet	Yes	Load present in chamber may be contaminated.	No	NA	Medium	Sterile grade vacuum break filter shall be considered with necessary connections.	Acceptable	OQ
25.	Filter sterilization	Filter Sterilization not possible.	Yes	Contamination of equipment or product possible	No	NA	High	Procedural control for the Sterilization of Vacuum break should be available.	Acceptable	OQ

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26.	Load patterns	Undefined / wrong Loading patterns	Yes	May lead to improper sterilization	No	NA	High	Loading patterns has to be defined and validated loading patterns should be defined in SOP	Acceptable	PQ/ SOP
27.	Heating time	Long Heating time	Yes	Cycle-time increases, negative influence on heat sensitive media possible	No	NA	Medium	Heat up time shall be optimize with Proper process designing.	Acceptable	OQ/ PQ
28.	Sterilization temperature	High Temperature during sterilization process	Yes	Negative influence on heat sensitive components	No	NA	Medium	Alarm provision for temperature overshoot shall be provided	Acceptable	OQ

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29.	Sterilization temperature	Low Temperature during sterilization process	Yes	Sterilization process out of validated range	No	NA	Medium	• If chamber temperature falls below specified level & the timer should stops counting. • If chamber temperature falls further below specified level the timer should reset. • Alarm provision for low temperature shall be provide	Acceptable	OQ
30.	Sterilization hold time	Sterilization hold time too short	Yes	Components remain un-sterilized	No	NA	High	• Appropriate sterilization cycles shall be design for complete sterilization of loads. • Sterilization cycles should be validated.	Acceptable	OQ/ PQ

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31.	Temperature control system	Incorrect temperature measurement (control system)	Yes	Sterilization out of validated procedure (monitoring by independent sensors)	No	NA	Medium	• Temperature sensors should be calibrated. • SOP “calibration and preventive maintenance”. • Independent temperature measurement (one for control one for monitoring)	Acceptable	OQ/ SOP
32.	Sterilization process end	Product will remain under the High temp. & High pressure influenced environment, even after the sterilization process is over.	Yes	Excess exposure will influence articles negatively.	No	NA	Medium	• Gasket release valve should get open automatically after the process ends. • Alarm should be provided to assure that the sterilization cycle has completed.	Acceptable	OQ

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33.	Sterilization time measurement	Time measurement works incorrect	Yes	Sterilization process insufficient	No	NA	High	• Periodic check of time measurement. • SOP “calibration and preventive maintenance” • Time synchronisation of system. • PLC Clock verification shall be performed.	Acceptable	OQ/ SOP
34.	Sterilization	Cold spots due to incomplete displacement of air	Yes	Sterilization process insufficient	No	NA	High	• Pre-sterilization vacuum cycle. • Temperature mapping of empty chamber, identification of “cold spot” during PQ. • “Mobile” temperature sensors within chamber for local temperature measurement at cold spot during sterilization cycle.	Acceptable	PQ

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35.	Drying with vacuum and post sterilization heating	No/Inadequate vacuum	Yes	Improper Moisture removal	No	NA	Medium	• Vacuum Pressure measurement with alarm provision. • SOP “calibration and preventive maintenance” (vacuum pump)	Acceptable	OQ/ SOP
36.	Drying with vacuum and post sterilization heating	Incorrect pressure measurement (control system)	Yes	Sterilization out of validated procedure (monitoring by independent sensors)	No	NA	High	• Pressure transmitter should be calibrated. • SOP “calibration and preventive maintenance”	Acceptable	IQ/ SOP
37.	Drying with vacuum and post sterilization heating	Failure of fractionated post-vacuum process	Yes	Sterilization out of validated procedure	No	NA	High	Cycle shall be design for porous load and validated	Acceptable	OQ/ PQ

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38.	Drying with vacuum and post sterilization heating	Vacuum pump fail	Yes	Drying out of Validated procedure.	No	NA	High	• Pressure measurement with alarm provision • SOP "Calibration and preventive maintenance" (vacuum pump)	Acceptable	OQ/SOP
39.	Pure steam generator	No pure steam	Yes	Basic requirement for steam sterilizer	No	NA	High	Inbuilt boiler to be provided for pure steam generation	Acceptable	IQ
40.	Purified water for Boiler	No /inadequate steam	Yes	Basic requirement for Boiler	No	NA	High	• Soft water should be supplied at the particular predefined temp. at pump inlet. • Pressure switch should be provisioned at pump inlet to monitor soft water pressure along with alarm provision.	Acceptable	IQ

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41.	Pure steam quality	Steam quality not adequate / Steam pressure conditions not adequate	Yes	Inadequate sterilization	No	NA	High	Qualification of steam generation. • Pressure gauge/ pressure switch to be provided at pure steam inlet line for monitoring and controlling of steam pressure, along with alarm provision. • Sampling valve shall be provide at inlet of steam for sampling. • Sampling valve shall be provide in condensate drain line for sampling of condensate steam pressure	Acceptable	IQ/ OQ

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42.	Soft Water for vacuum pump	Inefficient Vacuum	Yes	Inefficient sterilization & drying	No	NA	High	• Soft water should be supplied at the particular predefined temp. at pump inlet. • Pressure switch should be provisioned at pump inlet to monitor soft water pressure along with alarm provision. water pressure	Acceptable	IQ/OQ
43.	Compressed air	Insufficient pressure	Yes	Equipment operation will be disturbed	No	NA	High	Pressure gauge/ Pressure switch should be provisioned at compressed air inlet to monitor & control compressed air pressure along with alarm provision.	Acceptable	IQ/ OQ

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44.	Maintenance	Malfunctions due to worn parts	Yes	Basic GMP requirement	No	NA	High	• Machine shall be easy to maintain. • Preventive maintenance procedure should be available.	Acceptable	IQ/SOP
45.	Moving & electrical parts	Moving & electrical parts are not covered.	No	Does not have any impact on quality of the product	EHS	Operator safety	Medium	All moving & electrical parts are to be covered properly	Acceptable	IQ
46.	Utility	Failure of utility supply is not indicated	Yes	Process parameters may get disturbed	EHS	High pressure may cause accident	High	Various utilities like compressed air supply, Pure steam, plant steam, sealing water should be interlocked and indicated by alarm.	Acceptable	OQ
47.	Emergency stop	Instantaneous stopping of the equipment not possible	No	Does not have any impact on quality of the media/plates /articles	EHS	Emergency stop function is required for equipment, personnel and product protection	High	Emergency stop with alarm to be installed on accessible areas.	Acceptable	IQ/ OQ

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48.	Noise level	More noise is produced by the equipment during the operation	No	Does not have any impact on quality of the product	EHS	High noise may cause deafness and anxiety	Medium	Noise level shall be below 80db at a distance of 1 m from the equipment.	Acceptable	OQ
49.	Heating	Excess heating , Excess pressure & High Emission of Heat	No	NA	EHS	Environmental & operator safety hazards.	Medium	• Temperature of External surface should not more than 55°C. • SS304 Cladding should be provisioned for insulation. • Insulation material should be resin bounded glass wool/rock wool • Elevated temp. & pressure should be alarmed leading to the opening of the safety valve	Acceptable	IQ/OQ

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								Mitigation Method (9a)	Residual risk level (9b)	Verification (9c)
50.	Autoclave wall	Leakage in wall in which autoclave is integrated, between clean room grade D and grade A/B area	Yes	Pressure concept prevents contamination of clean room (overpressure in clean room)	No	NA	High	Bio seal barrier panel shall be installed between sterile room side and non sterile side.	Acceptable	IQ
51.	Pipeline	Steam leakage from the pipeline	Yes	Disturb room temperature and relative humidity	No	NA	High	Regular preventative Maintenance for pipeline to be done.	Acceptable	OQ/SOP
52.	Measuring Instruments	Measuring Instruments not suitable	Yes	Improper measurements	No	NA	High	• Measuring Instruments must have a suitable measuring range. • Operational range of Measuring instrument shall > equipment working range. • Must have appropriate accuracy.	Acceptable	IQ
53.	Measuring Instruments	Measuring instruments not calibrated Re-calibration not possible	Yes	Non calibrated Measuring instruments may lead to false machine functions	No	NA	High	It should be possible to calibrate /recalibrate Measuring instruments (3-point calibration, full loop calibration)	Acceptable	IQ

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54.	Measurement sensors	Sensors cannot be dismounted	Yes	Defective sensors must be dismounted for exchange and calibration	No	NA	High	• Mounting of sensors must give the possibility for dismounting and replacement. • Constructional solution: easy access for calibration activities shall be provided.	Acceptable	IQ
55.	Process automation	Process parameters are not controlled automatically	Yes	Possibility of human error	NO	NA	High	The system shall be PLC based and fully automatic	Acceptable	IQ/OQ
56.	Human - machine Interface	Process / process status not visible for operating personnel	Yes	Operating personnel must have the process status for control	No	NA	High	HMI /MMI shall be provided with adequate display and clean room suitable key board for operation	Acceptable	IQ/OQ

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57.	HMI/MMI language	Display language not identified.	Yes	Pre-requisite for the GMP compliant operation	No	NA	High	The language on the display of HMI/MMI should be English language only.	Acceptable	OQ
58.	HMI/MMI	Recorder failure	Yes	Basis GMP requirement (incomplete / no documentation)	No	NA	High	• Diagnostic function test to be a part of qualification activity. • Data backup of process data shall be provided.	Acceptable	OQ
59.	HMI/MMI	Monitoring/ recording and documentation of GMP relevant data not possible	Yes	Basic GMP requirement	No	NA	High	• It should be possible to monitor/record GMP relevant data. • Batch records / print outs to be defined. • Print out facility should be available with fade proof print.	Acceptable	OQ
60.	Control System	Control system does not detect failures and generate alarms	Yes	Process optimization and validation is not possible.	No	NA	High	Failure of set parameters gets indicated as alarm and machine stop.	Acceptable	OQ

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61.	PLC / Control system	Power failure / emergency stop	Yes	Process out of specification	No	NA	High	• Operator settings unchanged and restored after emergency stop / power failure; • Alarm message; • On recovery of a transient power failure the sterilization cycle should automatically. complete the remaining time, if sterilization time is maintained otherwise it will abort cycle. • SOP for 'Maintenance and operation of Steam Heat Sterilizer'.	Acceptable	OQ/SOP

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62.	PLC / Control system	Status parameters not clear	Yes	Process for the particular product at particular stage can't be regulated easily.	No	NA	High	• Status parameters should remain displayed at each process stage. • The flow of the process shall be provided with the help of arrows. • Alarm should also be visualized along with the fault displayed.	Acceptable	OQ
63.	Accessibility to PLC	Parameter settings not identified universally	Yes	Basic GMP requirement	No	NA	High	Parameters settings should be in numeric only.	Acceptable	OQ
64.	PLC / Control system	Time measurement works incorrect	Yes	Process insufficient	No	NA	High	• PLC Clock verification • SOP "calibration and maintenance" • Time synchronisation of system	Acceptable	OQ

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								Mitigation Method (9a)	Residual risk level (9b)	Verification (9c)
65.	PLC / Control system	No protection of PLC against manipulation & changes.	Yes	Basic GMP requirement.	No	NA	High	3 level password protections should be provided. Level 1: Operator level Level 2:Supervisor level Level 3:manager Level	Acceptable	OQ
66.	User	Faulty operation & maintenance	Yes	SOPs are basic GMP-requirement	No	NA	High	• All end-users have to be trained on SOPs • Training of SOPs has to be documented • Training on the job of end users by vendor • Training on operation, setting parameters, trouble shooting & maintenance related activities.	Acceptable	OQ/ SOP

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								Mitigation Method (9a)	Residual risk level (9b)	Verification (9c)
67.	User	Operation SOP does not contain proper information and user may operate system	Yes	User may make a wrong decision.	No	NA	High	• System operation SOP must be reviewed with all aspects and approved. • Vendor shall provide execution support to the user to complete all stages of the qualification report.	Acceptable	OQ

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								Mitigation Method (9a)	Residual risk level (9b)	Verification (9c)
68.	Vendor	Technical documentation from vendor not adequate	Yes	Adequate technical documentation is basic GMP requirement	No	NA	High	Vendor doc. (English) shall comprise: • FDS • Material certificates & surface finish reports • O&M manual • Calibration certificates • Software backup • Parts list (sufficient details - part no., supplier, type etc.) • Drawings (P&ID, GA, Power wiring etc.). • Certificates of bought out components. • Filter certificates • Hydro test certificates of pressure parts.	Acceptable	IQ

9.0 SUMMARY AND CONCLUSION:

- The Risk analysis is performed to establish the design parameters of the equipment so as to meet the desired performance of the equipment i.e. Steam Heat Sterilizer.
- The critical risks pertaining to GMP and other than GMP were analyzed with justification and mitigation procedures.
- For each recognized GMP-risk and other than GMP risks necessary measures are defined. Organizational measures, like SOPs, are also possible measures for special GMP-risks. The availability of these SOPs will be checked during the performance of the OQ.
- The risks where conceptual procedures shall be employed, standard operating procedures (SOPs), Preventive maintenance schedules, Certificates and related documents indicated as mitigation procedures shall be ensured at respective test points.

*"It is concluded that the **Risk Assessment** performed for the equipment will prevent the risk of failures of critical parameters during design, commissioning, installation, operation and performance of the equipment".*

10.0 ABBREVIATIONS:

Acronym	Definition
EU-GMP	European Good Manufacturing Practices
RAD	Risk Assessment Document
ICH	International Conference of Harmonization
QC	Quality Control
SHS	Steam Heat Sterilizer
GMP	Good Manufacturing Practice
EHS	Environment Health and Safety
VMP	Validation Master Plan
PVP	Project Validation Plan
SS	Stainless Steel
MOC	Material of Construction
P&ID	Piping And Instrumentation Diagram
IQ	Installation Qualification
DQ	Design Qualification
OQ	Operational Qualification
PQ	Performance Qualification
SOP	Standard Operating Procedure
PTFE	Polytetrafluoroethylene
AISI	American Iron and Steel Institute
HPHV	High Pressure High Vacuum
PW	Purified Water

HMI	Human Machine Interface
MMI	Man Machine Interface
PLC	Programmable Logic Controller
db	Decibel
FDS	Functional design specifications
GA	General Attachments
O&M	Operational and Maintenance Manual