Prepared by:	Position	Date:	Signature
s22	VP QA/RA	7.8.14	s22

Reviewed and approved by	Position	Date	Signature
s22	s22	7 Aug 2014	s22
s22		7 Aug 2014	
s22		7 Aug 2014	

Audit trail

REV.	BY	DATE	CHANGE
Ver 3.0	s22	14-Dec-2008	Overall review after V&V, Change wording of item 17 Add manufacturing risks
Ver 4.0	s22	27-Jan-2009	Add reference of V&V reports
Ver 5.0	s22	20-Aug-2009	Update following ECO001, ECO002 and ECO003
Ver 6.0	s22	25-Oct-2009	Update following KEMA response to ver 05, MDD 2007 Amendment, ECO002, ECO004
Ver 7.0	s22	03-Jan-2010	Update following KEMA response to ver 06 (A coating risks)
Ver 8.0	s22	February 7, 2011	Update following CCR002-risk 27 Ongoing RPNs scoring update and change in acceptance criteria table (page 3) - add "Tolerable" criteria
Ver 9.0	s22	January 23,2013	Update following ECO's: ECO024,ECO029, ECO030,ECO036 and CAPA038
Ver 10.0	s22	January 30,2013	Update following ECO 041
Ver 11.0	s22	May 28, 2013	Update following CCR006 – risk 8.1 Further review and updates according to the revised ISO14971:2012 standard – adding risks 3.1-3.3 & 26A. Fix few typo errors.
Ver 12.0	s22	June 20,2013	Following CCR8&9, add generic risk regarding system operation related to user error
Ver 13.0	s22	August 6, 2014	Adding relevant references to the one year shelf life testing documentation.

JustificJustification for Elast-Eon Incoming inspection

1 BACKGROUND

Gardia Medical develops a universal, short term Embolic Protection Device (EPD) – Wirion™.

EPDs are designed to minimize the risk of embolic events during cardiovascular interventions caused by blood clots or plaque that break loose during the procedure and may cause downstream obstruction of flow and damage to downstream tissue. The system collects and later retrieves the emboli and debris outside the patient body.

WIRION EPD consists of a percutaneously delivered Filter Unit, delivered to the target vessel using a Delivery Catheter. The Filter Unit consists of a Lock that is able to lock on any guide wire and a Filter attached to it. The Lock is activated by an internal activating wire mechanism running through the Delivery Catheter. It is connected to the Lock in its distal part and to an Activating Handle in its proximal part. After the Lock is activated, the Delivery Catheter is withdrawn while allowing the filter to passively deploy, and adjust to the vessel geometry. At this stage, the therapeutic part of the intervention takes place, while the filter collects debris and emboli. At the end of the procedure a Retrieval Catheter is inserted causing the filter to collapse and dragging the filter and guide wire out.

2 PURPOSE

The purpose of the risk management is:

- To identify and evaluate systematically potential hazards posed by the system consequences of any foreseen failure mode.
- To determine the controls for failure causes and failure modes.
- To determine the severity of consequences, their probabilities of occurrence and detectability.

The current revision was created as part of the shelf life accelerate aging testing for one year completion.
The following data was used for the review: V&V, PMS results, complaints.

3 REFERENCE DOCUMENTS

- Gardia Product Requirements # REQ-GEPD-1-02-01 rev. 12
- RMP001_Risk Management Plan
- QP7237 Rev A PFMEA Gardia Medical WIRION (Creganna)

3.1 Standards and guidance documents:

- ISO 14971: 2012 Medical Devices-Application of risk management to medical devices
- Medical Device Directive: 93/42/EEC & 2007/47/EC
- FDA - Design Control Guidance for Medical Device Manufacturers

- List of applicable standards SRL001 Rev 2.0
- FDA- Guidance for Industry and FDA Staff (2008): Coronary and Carotid Embolic Protection Devices - Premarket Notification [510(k)] Submissions

4 Device characteristics (based on Annex A of ISO 14971:2007)

4.1 General

This document covers the aspects of the Gardia Medical Embolic Protection device – WIRION.

4.2 Intended use

The WIRION is indicated for use as an embolic protection system to contain and remove embolic material while performing cardiovascular interventions.

Embolic material are blood clots, plaque or other solid substrates that break loose during the treatment procedure and enter into the blood stream resulting in downstream obstruction and damage to the end organ.

The WIRION system is deployed downstream from the stenosis or the stent deployment zone. The system collects and later retrieves the emboli and debris outside the patient body.

4.3 Contact with patients and operators

The device includes **three** major components:

- **Delivery Catheter**- an independent device (catheter based) used to bring the EPD to the operation site and lock it on the guide wire and deploy against the vessel wall.
- **EPD** –a miniature device which captures the debris during the procedure and then enables to remove them out of the body. The EPD will be in contact with the blood vessel during the procedure which normally will last for 15- 30 minutes. The EPD is made of two main components: a locking member and a filter.
- **Retrieval Catheter-** a catheter which enables to fold the EPD and retrieve it safely with the guide wire

The operator will be in contact with the Delivery Catheter and the Retrieval Catheter for several minutes before and during the procedure.

4.4 Materials and components

The WIRION Systems are made of commercial off the shelf components such as 304 Stainless Steel, Nitinol, Pebax, PTFE, Polyimide tubing, Hydrophilic coating, Nylon 12, plastic handles, etc., and adhesive components

All components are based on biocompatible materials. Biocompatibility tests were performed according to ISO10993-1.

4.5 Energy delivered to and/ or extracted from the patient

N/A

4.6 Substances delivered to and/ or extracted the patient

N/A

4.7 Biological materials processed by the device for subsequent reuse

N/A

4.8 Sterilization issues

The WIRION system is sterilized by the EtO sterilization method. The System is disposable.

4.9 Modifications of patient environment

N/A

4.10 Are measurements taken?

N/A

4.11 Interpretation of the device measurements

N/A

4.12 Conjunction with medicines or other medical technologies?

Routine catheterization lab procedures (Angiography, angioplasty, GW, Heparin, dye, etc.)

4.13 Unwanted outputs of energy / substances

N/A

4.14 Susceptibility to environmental influence

Transport and storage environment – beyond allowed temperature device may be damaged.

4.15 Device influence on the environment

N/A

4.16 Essential consumables or accessories associated with the device.

Guide wires from all kinds.

Cath-lab standard equipment.

4.17 Maintenance and calibration

N/A

4.18 Does the device contain software?

N/A

4.19 Restrictions on shelf life

The WIRION is designed for shelf life of 2 years (4 months at launch).

4.20 Possibility for delayed / long term effects

N/.A

4.21 Mechanical forces in transportation, implantation and use

During use, the device components will withstand the normally expected conditions of performance in Cath-lab

4.22 What determines the device life time?

Shelf life validation

4.23 Is the device intended for single use?

Yes

4.24 Is a safe decommissioning or disposal of the medical device necessary?

Device is in contact with blood, and thus is a biohazard

4.25 Does installation or use of the medical device require special training?

The implanting physician should be trained in cardiovascular / endovascular interventional procedures.

4.26 Will new manufacturing processes need to be established or introduced?

No

5 Main Hazard Areas

5.1 Energy hazards and contributory factors

- Electricity: N/A
- Heat: N/A
- Mechanical force: **Handled in FMECA**
- Ionizing radiation: NA
- Non-ionizing radiation: NA
- Electromagnetic fields: N/A
- Moving parts: **Handled in FMECA**
- Suspended massed: N/A
- Patient support device failure: N/A
- Pressure (vessel rupture): N/A
- Acoustic pressure: N/A
- Vibration: N/A
- Magnetic fields: MRI safety N/A

5.2 Biological

- Bio-burden: **Handled in FMECA**
- Bio-contamination / Bio-burden **Handled in FMECA**
- Bio-incompatibility: **Handled in FMECA**
- Incorrect output: N/A
- Incorrect formulation: N/A
- Toxicity: **Handled in FMECA**
- Allergenicity: **Handled in FMECA**
- Mutagenicity: N/A
- Oncogenicity: N/A
- Teratogenocity: N/A
- Re-and/or cross infection: N/A
- Pyrogenicity: **Handled in FMECA**
- Inability to maintain hygienic safety: N/A

- Degradation: N/A

5.3 Environmental hazards and contributory factors

Handled in FMECA

5.4 Hazards resulting from incorrect output of energy and substances

N/A

5.5 Hazards related to use of the medical device and contributory factors

- Inadequate labeling: **Handled in FMECA**
- Inadequate operating instructions: **Handled in FMECA**
- Inadequate specification of accessories: **Handled in FMECA**
- Inadequate specification of pre-use checks: N/A
- Over-complicated operating instructions: **Handled in FMECA**
- Unavailable or separated operating instructions: N/A
- Use by unskilled/untrained personnel: **Handled in FMECA**
- Reasonably foreseeable misuses: **Handled in FMECA**
- Insufficient warning of side effects: **Handled in FMECA**
- Inadequate warning of hazards likely with re-uses of single use devices: **Handled in FMECA**
- Incorrect measurement and other metrological aspects: N/A
- Incorrect diagnosis: N/A
- Erroneous data transfer: N/A
- Misrepresentation of results**:** N/A
- Incompatibility with consumables/accessories/other devices: **Handled in FMECA**

5.6 Functional failure, maintenance, aging

- Inadequacy of the performance characteristics for the intended use: **Handled in FMECA**
- Lack of, or inadequate, specification for maintenance including spec for post maintenance functional checks: N/A
- Inadequate maintenance: N/A
- Lack of or inadequate determination of end of device life: N/A
- Loss of mechanical integrity: **Handled in FMECA**
- Inadequate packaging (deterioration of the device): **Handled in FMECA**
- Improper re-use: N/A

6 Risk Management

The risk management was performed using the FMECA method

6.1 FMECA team

The initial FMECA team was composed of:

s22

The team that revised the Risk management (Rev 2.0 - 5.0) was composed of:

s22

The team that revised the Risk management (Rev 6.0 - 7.0) was composed of:

s22

The team that revised the Risk management (Rev 8.0) was composed of:

s22

The team that revised the Risk management (Rev 9.0) was composed of:

s22

The team that revised the Risk management (Rev 10.0-13.0) was composed of:

s22

7 FMECA methodology

- Reference
  Reference number for reference purposes.
- Failure mode.
  What can go wrong. The failure modes (or their causes) shall be covered by design or process requirements.
- Failure causes
  The causes of the failure mode.
- Occurrence (O)
  Probability of Failure Occurrence. See table 1.
  - The Occurrence after mitigation takes into consideration the effectiveness of the safeguards and verification/validation process to minimize Occurrence to rare or improbable level.
  - Possibility of detection before occurrence may be considered when estimating the probability.
- Failure local effect.
  What is the immediate failure effect
- Failure end effect.
  What is the end effect, as close as possible to the customer
- Severity (S)
  The severity of the failure effect, see table 2.
- Risk index / Risk Priority Number (rpn) (occurrence * severity), see table 3.
  The risk index is used for evaluation of the risk severity before and *after mitigation.
- Safeguards
  How the design input, characteristics and output are used to prove that the design can deliver an acceptable output, considered are:
  - Design qualification.
  - Design validation specs.
  - Material specs.
  - Device specs.
- Verification
  How the design input, characteristics and output are verified to prevent failure modes.

- Design validation.
  Animal and Clinical studies
- Inspections
  The failure mode or the failure causes, as a minimum, shall be controlled.
- Acceptability
  The acceptability of the outcome. (Y= acceptable, N= not acceptable). See acceptance criteria in table 3

Table 1. Occurrence of the Effect (O)

Occurrence	
Rating	**Number of failures**
5	Frequent
4	Probable
3	Occasional
2	Rare
1	Improbable

Table 2. Severity of the Effect (S)

Weight		Severity
5	Critical	Potential of death or serious injury
4	Major	Potential of injury
3	Moderate	Little potential of injury
2	Minor	Customer dissatisfaction
1	Negligible	Violating specifications without consequences

Table 3: Acceptance criteria

Risk priority number rating (final):	Acceptance criteria	Action Required
rpn ≤ 6	Acceptable (Y)	No Action Required
8 ≤ rpn ≤ 12	Tolerable (T)	The RPN should be lowered if possible
15 ≤ rpn ≤ 20	Not Acceptable (N)	The RPN should be lowered
rpn > 20	Not Acceptable – Intolerable (NI)	The RPN should be lowered- Project feasibility re evaluation, should be considered

8 FMECA results

The FMECA table summarizes the results for the WIRION system.

FMECA Table

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
1	Shipment	Receive package	Package is damaged	Package is punctured or open	4	Pouch seal does not suit product and transportation Package design not optimized	Device – non sterile	Patient infection, Procedure complication	4	16	N	Design package according to design control procedure and comply with packaging standard for medical devices ISO_11607-1 Requirements: REF: REQ-GEPD-1-02-01, sections 5.4.60, 5.4.70, 5.4.80, 5.4.85 Ref: ATP021_ ISTA 2A Package Performance Testing Protocol REF: ETP028- V&V Test Plan, Table A- tests 16 ,17 System Package Validation- Transportation and shelf life REF: ETP106 - Validation and Verification Test Plan Table A-test 12 Performance & Integrity Test after Transportation test	Package validation and verification A-0004436-1 transportation test report A-0004436-2_Shelf life interim report -4 month TR7236-5 Packaging Validation and Shelf Life IFU - REF: P1-5-0721, under warnings ETP028-R01, Validation and Verification Summary Report ETP056-R06, Performance & Integrity Test after Transportation test, Test Report E068 WIRION system shelf life rationale ETP132-R01 Product performance & package integrity test report after 1 year accelerated aging	1	4	4	Y
1b	Shipment	Receive package	Product damaged	Mechanical damage to product	4	Packaging does not protect product during transportation	Catheter kinks or breaks User aware	Product replacement	3	12	T	Packaging shall maintain system intact following transportation challenging Requirements: REF: REQ-GEPD-1-02-01, sections 5.4.60, 5.4.70, 5.4.85 Ref: ATP021_ ISTA 2A Package Performance Testing Protocol REF: ETP028- V&V Test Plan, Table A- test 16, System Package Validation- Transportation **ETP059- V&V Test Plan, Table A- test17 determine the ability of product to maintain performance throughout 4 months shelf life (accelerated aging)**	Package validation and verification A-0004436-1 transportation test report TR7236-5 Packaging Validation and Shelf Life ETP028-R01, **ETP059-R01** Validation and Verification Summary Reports ETP056-R01- Product performance after shelf life_ Test Report ETP132-R01 Product performance & package integrity test report after 1 year	1	3	3	Y
							Catheter Shaft kinks or breaks User unaware	Procedure complication/ User injury	4	16	N			1	4	4	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
												ETP056_ Performance Test after Packaging Transportation test and Shelf Life Acclimation ETP132- Product performance & package integrity test protocol after 1 year accelerated aging	accelerated aging				

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
1c	Storage and Shelf life	Receive package	Product is damaged	Product poor stabilizatio n	4	Reduction of Product performance during shelf life due to materials deterioration	Catheter kinks or breaks User aware	Product replacement	3	12	T	Design Filter component's materials and mechanical strength to comply with EN ISO 10555-1 Packaging shall be tested according ISO11607 to maintain sterility for 2 years shelf life (4 months at launch) REF: REQ-GEPD-1-02-01, sections 5.4.80 REF: ETP028, - V&V Test Plan, Table A- test 10 System Package Validation- shelf life **ETP059- V&V Test Plan, Table A- test17 determine the ability of product to maintain performance throughout 4 months shelf life (accelerated aging)** ETP056_ Performance Test after Packaging Transportation test and Shelf Life Acclimation ETP132- Product performance & package integrity test protocol after 1 year accelerated aging Filter manufacturing process should be validated from production through shelf life	TR7236-5 Packaging Validation and Shelf Life A-0004436-2_Shelf life interim report -4 month ETP028-R01, **ETP059-R01** Validation and Verification Summary Reports ETP056-R01, **ETP056-R03-** Product performance after shelf life_ Test Report ETP056-R06, Performance & Integrity Test after Transportation test, Test Report E068 WIRION system shelf life rationale ETP132-R01 Product performance & package integrity test report after 1 year accelerated aging	1	3	3	Y
							Catheter kinks or breaks User unaware	Procedure complication/ User injury	4	16	N			1	4	4	Y
							Reduced filter wall apposition characteristics	Procedure complication due to embolization	5	20	N			1	4	4	Y
			Package is damaged	Package is open	4	Poor Pouch seal	Device – non sterile	Patient infection, Procedure complication	4	16	N			1	4	4	Y
					2	Cracks in folded oversized pouches	Device – non sterile	Patient infection, Procedure complication	4	8	Y			1	4	4	Y
2	Opening during Procedure	Open package	Package difficult to open	Non sterile opening Device "jumps" out of package	3	Pouch seal is too strong Package opening mechanism do not suit user needs	Device - non sterile Damage to device	Product replacement	2	6	Y	Design package according to design control procedure and comply with packaging standard for medical devices ISO_11607-1 Requirements: REF: REQ-GEPD-1-02-01, sections 5.4.60, 5.4.70, 5.4.80 Ref: ATP021_ ISTA 2A Package Performance Testing Protocol , section 20.6	Package validation and verification A-0004436-1 transportation test report A-0004436-2_Shelf life interim report -4 month TR7236-5 Packaging Validation and Shelf Life IFU- REF: P1-5-0721, under warnings	1	2	2	Y
							Damage to device	User injury	3	9	T			1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
3	Delivery catheter insertion over the wire	Before insertion to patient	Catheter insertion failure	Failure to go over the wire	4	Damaged or kinked delivery catheter Damaged or kinked wire	Delivery catheter cannot be inserted Delivery catheter is stuck on the wire Delivery catheter and wire are stuck	Flush and retry insertion Replace device Remove delivery catheter and wire and replace Procedure elongation	3	12	T	Design control: Design delivery catheter for smooth insertion and delivery Requirements: REF: REQ-GEPD-1-02-01, section 5.1.130 Design control: Design a colorant soft tip material in order to Enhance ease of use of catheter delivery insertion over the guide wire REF: ETP028,059 - V&V Test Plan, Table A- test 1,2 (2D,3D) 12,13 (Torque Testing) and Animal Study ATP002,003	Verification and validation. Tests with various guide wires ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01_Animal Study report	1	3	3	Y
3.1	**Delivery catheter**	Before insertion to patient	Delivery system damage	Filter locking failure	1	Handle was activated prior guide wire threading/tracking to position	The system cannot lock the filter on the guide wire. Locking mechanism is not effective. Uncontrolled filter deployment may occur	Procedure complication and elongation	5	5	A	Validated IFU to cover failure local effect activities	IFU REF: P1-5-0721 Instruction for use.	1	5	5	Y
3.2	Delivery catheter insertion over the wire	Before insertion to patient	Catheter insertion failure	Failure to go over the wire	2	User error, physician forgot to remove stylet prior guide wire threading	Delivery catheter cannot be inserted Delivery catheter and wire are stuck outside the patient body	Procedure elongation	2	4	A	Design control: Stylet diameter design cannot allow insertion of both guide wire and stylet within the Delivery catheter tip. In order to thread the Delivery system over the guide wire the stylet must be removed.	Verification and validation. Tests with various guide wires ETP028-R01, ETP059—R01_ Validation and Verification Summary Report	2	2	4	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
3.3	Delivery catheter insertion over the wire	Before insertion to patient	Catheter insertion failure	Failure to go over the wire	1	User error, physician use a lager guide wire than 0.014"	Delivery catheter cannot be inserted	Procedure elongation	2	2	A	Validated IFU to cover failure local effect activities	IFU REF: P1-5-0721 Instruction for use.	1	2	2	A
4	Delivery catheter insertion over the wire	After insertion to patient	Catheter insertion failure	Failure to go over the wire	4	Damaged or kinked delivery catheter Damaged or kinked wire Delivery catheter characteristics do not allow movement Tortuous vessel	Delivery catheter cannot be inserted Delivery catheter is stuck on the wire Delivery catheter and wire are stuck	Flush and retry insertion Replace device Remove delivery catheter and wire and replace Procedure elongation	3	12	T	Design control: Design delivery catheter for smooth insertion and delivery in tortuous vessel geometrics Requirements: REF: REQ-GEPD-1-02-01, section 5.1.130 REF: ETP028,059 - V&V Test Plan, Table A- test 1,2 (2D,3D) 12,13 (Torque Testing), Tensile Strength ETP028 -19, ETP059- 12), and Animal Study ATP002,003	Verification and validation. Tests with various guide wires ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01 _Animal Study report	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
5	Delivery catheter in the target vessel	Track catheter to position	Tracking inability	Device advancement is not fluent.	4	Inappropriate catheter characteristics: Low trackability and pushability Catheter crossing profile is too big	Device cannot be placed in position	Device not used Potential complications : remove and replace device	3	12	T	Delivery catheter design: mechanical characteristics, low crossing profile, nose cone, soft tip. Requirements: REF: REQ-GEPD-1-02-01, section: 5.1.30-Catheter crossing profile Ø 1.1 ± 0.1 mm 5.1.10- RX system 5.1.40 (Catheter trackability- Tracking force ≤ 8N REF: ETP028,059 - V&V Test Plan, Table A- test 1,2 (2D,3D) 12,13 (Torque Testing) and Animal Study ATP002,003	Validation and verification in tortuous geometries + Comparative studies with predicate devices Drawing D-P2-2-0221 Drawing: Oracle 131404-02 ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01_Animal Study report_	1	3	3	Y
6	Delivery catheter in the target vessel	Track catheter to position	Damage to vessel wall	Delivery catheter tip touches the vessel wall	4	Low trackability and pushability in tortuous vessels Tip is not soft	Vessel injury	Procedure complication and elongation	5	20	N	Delivery catheter design: mechanical characteristics, low crossing profile, nosecone , soft tip. Requirements: Ref: REF: REQ-GEPD-1-02-01, section 5.2.80 Validation and verification in tortuous geometries (Comparative study with predicate devices)REF: ETP028 - V&V Test Plan, Table A- test 14 – Tip Flexibility, 12,13(Torque Testing) Animal study # ATP002,003	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01_Animal Study report_	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
7	Delivery catheter in the target vessel	Track catheter to position	Premature deployment	Premature deployment while **in the** Guiding catheter	3	Damaged delivery system (manufacturing problem). partial and unintentional filter locking	Remove and replace device and wire	Procedure elongation	3	9	T	Design of delivery catheter's locking system to avoid unintentional activation by adding locking safety mechanism Requirements Ref: REF: REQ-GEPD-1-02-01, section 5.1.110 Validation and verification: REF: ETP028 - V&V Test Plan, Table A- test 1,2 (2D,3D), 10 (safety sticker) ETP059 Animal Study ATP002,003 Validated IFU to cover failure local effect activities	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01_Animal Study report_ IFU REF: P1-5-0721 Instruction for use.	1	3	3	Y
8	Delivery catheter in the target vessel	Track catheter to position	Premature deployment	Premature deployment while **out** of the Guiding catheter	3		If possible, retrieve filter using the retrieval catheter Otherwise, use alternative methods to retrieve	Procedure complication and elongation	4	12	T			1	4	4	Y
8.1	**Re tracking of Delivery catheter**	Track catheter to position	Premature deployment	Unintentional filter deployment due to user error	1	Re-use of the system prior filter locking within the same patient	**Outside patient:** replace system **Inside patient:** If possible, retrieve filter using the retrieval catheter Otherwise, use alternative methods to retrieve. Replace system	Procedure complication and elongation	5	5	A	Validated IFU to cover failure local effect activities	IFU REF: P1-5-0721 Instruction for use.	1	5	5	A
9	**Visibility**	Device placement at desired location	Device not visible	Device is not visible under angiography	4	Radiopaque markers malfunction	Unable to position the device	Replace system Procedure elongation	3	12	T	Design for proper visibility, e.g. radiopaque markers Increasing frame visibility- gold coating Requirement REF: REQ-GEPD-1-02-01, section 5.2.60, 5.3.30 (Visibility) Validation and verification , Compare visibility to predicate device. Verify visibility in Animal study ATP002,003 REF: ETP106 - Validation and Verification Test Plan	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP002, ATP003-R01_Animal Study report_ ETP106-R01 Validation and Verification Summary Report	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
10	**Locking**	Activate locking handle	Device doesn't lock	Device cannot be deployed – physician aware	4	Handle failure Activating wire broken/stuck Locking tube is broken Catheter collapse/kinked	Unable to lock and deploy	Replace system Procedure elongation	3	12	T	Design control – Requirement- Mechanical force characteristics, according to EN ISO 10555-1 REF: REQ-GEPD-1-02-01- Catheter force resistance section 5.1.50 – 5.1.100 Handle feedback mechanism section 5.1.120 Validation and verification REF: ETP028 - V&V Test Plan, Table A- tests 4, 10 19, 19.1, ETP059 V&V Test Plan, Table A- tests 4, 12 Animal study-ATP003 Creganna verification protocol Ref: DV7236	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP003-R01_Animal Study report_ TR7236-2 Rev.02 Design Verification Test Report	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
11	Locking	Activate locking handle	Device doesn't lock	Device cannot be deployed – physician not aware	4	Handle failed Activating wire broke Locking tube is broken Locking mechanism does not function High friction force between AW and DC Catheter collapse	Unable to lock and deploy Delivery catheter removal together with device	Replace device Procedure complication and elongation	4	16	N	Design control: Handle feedback mechanism Requirement: REF:REQ-GEPD-1-02-01, section 5.1.120 Design Handel in ergonomic way: Design handle to avoid hand slipping and glove pinching Handle will be designed for use in ergonomic force magnitude Requirement: REF:REQ-GEPD-1-02-01, section 5.1.110 Mechanicalff force characteristics, according to EN ISO 10555-1, Design delivery catheter in order to minimize friction force between Activating wire and Delivery Catheter. Requirement: REF:REQ-GEPD-1-02-01, section 5.1.90 Validation and verification: using controlled and defined tortuosity vessels simulator REF: ETP028 - V&V Test Plan, Table A- tests 1,2 (2D,3D), test 19-Tensile Strength , ETP059- V&V Test Plan, Table A- tests 1,2 (2D,3D), test 12-Tensile Strength , Animal study-ATP003 Creganna verification protocol Ref: DV7236	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report ATP003-R01_Animal Study report_ TR7236-2 Rev.02 Design Verification Test Report QC – Incoming procedure for Activating Wire REF: REF: ICP003_ Activating Wire	1	4	4	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
12	Locking	Locking in position	Device is not fixed in place	Partial locking	3	Handle failed Activating wire broke Locking tube is broken Locking mechanism do not function High friction force between AW and DC	Device is moving on the wire	Procedure complication and elongation : Replace device Potential need for device retrieval/rescue	5	15	N	Design control: Handle mechanism Mechanical force characteristics, according to EN ISO 10555-1, Design delivery catheter in order to minimize friction force between AW and DC. Requirement: REF:REQ-GEPD-1-02-01, section 5.1.90 Validation and verification : REF: ETP028, 059 - V&V Test Plan, Table A- tests 1,2 (2D,3D)	ETP028-R01, ETP059—R01_ Validation and Verification Summary Report QC – Incoming procedure for Activating Wire REF: REF: ICP003_ Activating Wire	1	5	5	Y
13	Locking	Locking in position	Device mis-positioned	Device locked not in place		User error: Lack of training. Unclear Instruction For Use.	Device in wrong location	Adjust position if possible Replace Device and wire	3	9	T	IFU are clear and reviewed by physicians (Interventionalist)	IFU REF: P1-5-0721 _Instruction for use.	1	3	3	Y
					3	Device malfunction: Catheter movement during locking and deployment	Device in wrong location	If filter is deployed, retrieve and replace device and wire	3	9	T	Design control: Restrict acceptance criteria for catheter movement during locking and deployment due to device performance to +- 4mm Requirement: REF:REQ-GEPD-1-02-01, section 5.2.91 Validation and verification : Validate ease of use and device positioning at extreme condition (tortuous vessels) REF: ETP028, 059 - V&V Test Plan, Table A- test 2 (2D)	ETP028,059-R01_ Validation and Verification Summary Report. TR7236-2 Rev.02 Design Verification Test Report	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
13a	Locking	Locking in position	Device mis-positioned	Device locked not in place	3	Pre mature Activation of the lock	Device in wrong location	Adjust position if possible Replace device and wire	3	9	T	Design the locking system to avoid unintentional activation by adding safety mechanism Requirement: REF:REQ-GEPD-1-02-01, section 5.1.110 Validate handle and locking performance in-vitro and in animal studies. REF: ETP028, - V&V Test Plan, Table A- test 1,2 (2D ,3D), test 10 (Handle Performance) ETP059 V&V Test Plan, Table A- test 1,2 (2D ,3D) Animal Study protocol # ATP002,003	ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report	1	3	3	Y
14	Delivery Catheter withdrawal Filter deployment	Delivery Catheter is pulled back	Catheter doesn't move	Catheter is stuck	3	Delivery catheter or wire kink (manufacturing problem) Catheter collapse High friction force between catheter and filter	Cannot deploy filter	Replace device and wire Procedure elongation	3	9	T	Design control: Design system to reduce friction force between catheter and filter unit Requirement : low friction coating : Hydrophilic coating shall be applied to the filter over tube REF:REQ-GEPD-1-02-01, section 5.2.70 Validate the deployment stage at high tortuosity path conditions REF: ETP028, 059 - V&V Test Plan, Table A- test 1,2 (2D,3D) Animal study # ATP002,003	ETP028,059-R01_ Validation and Verification Summary Report. ATP002, 003-R01_Animal Study report	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
15	Delivery Catheter withdrawal	Filter deployment	Filter does not open	Physician is aware	4	Filter damage or malfunction: 1. Filter sac is damaged during storage 2. Filter frame lost its shape memory during storage	Retrieve device and wire and replace	Procedure elongation	3	12	T	Design and validate manufacturing process and packaging to eliminate device damages during assembly stages. Use of appropriate metal frame material (e.g. Nitinol), with an approved shape memory characteristics, for the specified condition of use. Ref: REQ-GEPD-1-02-01, section 5.2.10, 5.2.41 REF: ETP028, 059 - V&V Test Plan, Table A- tests 1,2 (2D,3D) Animal study ATP002,003 Validate shelf life for shape memory and filter sac integrity characteristics Ref: ATP021_ ISTA 2A Package Validation Protocol REF: ETP106 - Validation and Verification Test Plan ETP132- Product performance & package integrity test protocol after 1 year accelerated aging	ETP028,059-R01_ Validation and Verification Summary Report. ATP002, 003-R01_Animal Study report TR7236-5 Packaging Validation and Shelf Life ETP056-R01: product Performance after Transportation and Shelf Life Study ETP106-R01Validation and Verification Summary Report ETP056-R06: Performance & Integrity Test after Transportation test, Test Report E068 WIRION system shelf life rationale ETP132-R01 Product performance & package integrity test report after 1 year accelerated aging	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
16	Delivery Catheter withdrawal	Filter deployment	Filter does not open	Physician is not aware	4	Filter damage or malfunction: 1. Filter sac is damaged during storage 2. Filter frame lost its shape memory during storage 3.Poor filter visibility	No filtration	Procedure complication due to embolization	5	20	N	Design and validate manufacturing process and packaging to eliminate device damages during assembly stages. Use of appropriate metal frame material (e.g. Nitinol), with an approved shape memory characteristics, for the specified condition of use. Ref: REQ-GEPD-1-02-01, section 5.2.10, 5.2.20, 5.2.41 REF: ETP028, 059- V&V Test Plan, Table A- tests 1,2 (2D,3D) Design filter with good radiopacity – Increasing frame visibility- gold coating Ref: REQ-GEPD-1-02-01, section 5.2.60_visibility Verify visibility in vivo (animal study) Animal study ATP002,003 Validate shelf life for shape memory and filter sac integrity characteristics REF: ETP028 - V&V Test Plan, Table A- tests 17 ETP059 - V&V Test Plan, Table A- tests 10 REF: ETP106 - Validation and Verification Test Plan ETP132- Product performance & package integrity test protocol after 1 year accelerated aging	ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report TR7236-5 Packaging Validation and Shelf Life ETP056-R01: product Performance after Transportation and Shelf Life Study ETP106-R01Validation and Verification Summary Report ETP056-R06: Performance & Integrity Test after Transportation test, Test Report E068 WIRION system shelf life rationale ETP132-R01 Product performance & package integrity test report after 1 year accelerated aging	1	5	5	Y
17	Device function	Filter open against vessel wall	Sub-optimal wall apposition	Sub-optimal protection	4	Filter Malfunction: Filter frame shape	Partial protection against	Procedure complication due to	5	20	N	Use of appropriate metal frame material (e.g. Nitinol), with an approved shape memory characteristics..	ETP028,059-R01_ Validation and Verification Summary	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
						memory is not optimal Filter frame design do not support good wall apposition.	embolization	embolization				Ref: REQ-GEPD-1-02-01, section 5.2.10, 5.2.41 Optimize filter frame memory shape status (mechanical treatment) Validate vessel wall apposition in bench model at different vessel size according to intended use. REF: ETP028,059 - V&V Test Plan, Table A- test 3- Filter Particle Capture Validate shelf life for shape memory characteristics Ref: ATP021_ ISTA 2A Package Validation Protocol Animal study ATP003 REF: ETP106 - Validation and Verification Test Plan ETP132- Product performance & package integrity test protocol after 1 year accelerated aging	Report. ETP056-R01: product Performance after Transportation and Shelf Life Study ATP,003-R01_Animal Study report ETP106-R01Validation and Verification Summary Report ETP056-R06: Performance & Integrity Test after Transportation test, Test Report E068 WIRION system shelf life rationale ETP132-R01 Product performance & package integrity test report after 1 year accelerated aging				

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
18	**Device function**	Filter open against vessel wall	Filter mal-sizing	Oversizing Undersizing	4	User error Filter size design is not optimized for the target vessel	Injury to blood vessel, increased risk for clots Limited protection from embolization	Procedure complication Need for vessel wall repair Higher risk of embolization	5	20	N	Large indication of the filter size in IFU and in product inner and external packaging labels. IFU caution: Physician training Optimize filter frame memory shape status (mechanical treatment). Validate vessel wall apposition in bench model at different vessel size according to intended use. Ref: REQ-GEPD-1-02-01, section 5.2.10, 5.2.41 REF: ETP028,059 - V&V Test Plan, Table A- test 3- Filter Particle Capture REF: ETP106 - Validation and Verification Test Plan	Ref : P1-5-0721 WIRION IFU IFU caution: "To prevent overstretching and potential dissection of the artery, make sure the selected device size matches the reference vessel diameter". ETP028,059-R01_ Validation and Verification Summary Report. ETP106-R01Validation and Verification Summary Report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
19	**Device function**	Filter open against vessel wall	Sub-optimal Radial strength	Device malfunction Damaged filter	4	Radial strength too big	Injury to blood vessel Filter collapse	Procedure complication Need for vessel wall repair	5	20	N	Optimize design of filter frame radial strength in order to achieve good wall apposition without tissue damage. Validate radial force compare to predicate device: REF: ETP028 - V&V Test Plan, Table A- test 11_ Filter Radial Force. ETP059- V&V Test Plan, Table A- test 9_ Filter Radial Force. Validate vessel tissue condition in vivo (animal studies) e.g. histopathology analysis for local tissue damage.- Ref: Animal study #ATP002.003 REF: ETP106 - Validation and Verification Test Plan	ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report ETP106-R01Validation and Verification Summary Report	1	5	5	Y
20	**Device function**	Filter open against vessel wall	Filter failure	Damaged filter	3	Filter torn or distorted	Compromised filtration Disturbance to flow Problematic retrieval	Procedure complications and elongation	5	15	N	Design Filter component's materials and mechanical strength to comply with EN ISO 10555-1 Validate filter performance in bench model for the following characteristics: REF: ETP028,059 - V&V Test Plan, Table A- test 3 - Filter Particle Capture Test 5 - Filter Pressure Endurance Animal study # ATP002,003 REF: ETP106 - Validation and Verification Test Plan	ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report ETP106-R01Validation and Verification Summary Report	1	5	5	Y
21	**Device function**	Filter Open against vessel wall	Filter frame failure	Damaged filter frame	3	Sharp edges on the filter frame	Vessel Injury Balloon rapture/torn	Procedure complication-Compromised filtration	5	15	N	Design frame mechanical treatment and surface finish for smooth and round surface QC – 100% visual inspection	REF: Filter frame EP, L- Incoming process document: ICP024	1	5	5	Y
22A	**Device function**	Filter open against vessel wall	Fatigue resistance	Damage to the filter frame	3	Frame fracture due to cyclic loading	Filter collapse	Compromised protection	5	15	N	Design high quality material and strong structural frame shape. Validate cyclic loading over 2-4 hours of operation REF: ETP028,059 - V&V Test Plan,	ETP028,059-R01_ Validation and Verification Summary Report. ETP106-R01Validation and Verification Summary Report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
												Table A- test 4, Filter Fatigue REF: ETP106 - Validation and Verification Test Plan					
23	**Perform rest of intervention**	Therapeutic phase	Not able to maneuver balloon and/or stent	Distortion of therapeutic procedure	3	GW damaged during delivery Filter malposition	Unable to proceed in procedure Adjust filter position or replace whole system	Procedure complication and elongation	3	9	T	Design catheter with RX system in order to minimize interaction with wire. Ref: REQ-GEPD-1-02-01, section 5.1.10- Catheter type Validate full procedure, ease of use and wire integrity REF: ETP028,059 - V&V Test Plan, Table A- test 1,2 (2D,3D) Animal study # ATP002,003	Drawing: Oracle 131404-02 ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report	1	3	3	Y
24	**Filter performance**	Therapeutic phase	Filter capture efficiency	Filter does not capture debris	3	Damaged filter Filter mal-position Sub optimal wall apposition	Compromised protection	Procedure complication	5	15	N	Design Filter component's materials and mechanical strength to comply with EN ISO 10555-1 Ref: ETP028 - V&V Test Plan, Table A- test 19- Tensile Strength Design filter holes number and size to assure effective filtration. Ref: REQ-GEPD-1-02-01, section 5.2.10 Validate vessel wall apposition in bench model at different vessel size according to intended use. Optimize filter frame memory shape status (mechanical treatment) Ref: REQ-GEPD-1-02-01, section 5.2.41 REF: ETP028,059 - V&V Test Plan, Table A- test 3- Filter Particle Capture Validate filter performance and strength in vitro and in animal studies Ref: REF: ETP028,059 - V&V Test Plan, Table A- test 1,2 (2D,3D), 4 Filter Fatigue, 5 Filter Pressure Endurance Ref: Animal study ATP002,003 REF: ETP106 - Validation and Verification Test Plan	TR7236-2 Rev.02 Design Verification Test Report ETP028,059-R01_ Validation and Verification Summary Report. ATP002,003-R01_Animal Study report ETP106-R01Validation and Verification Summary Report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
25	**Filter performance**	Therapeutic phase	Filter full	Compromised flow	3	Capture volume is too small	Need to retrieve filter and replace with a new device	Procedure complication and elongation	3	9	T	Design filter size similar to predicate device. Ref: REQ-GEPD-1-02-01, section 5.2.20 Validate vessel wall apposition in bench model (particles capturing capacity) at different vessel size according to intended use, and compare results to predicate devices. Ref: REQ-GEPD-1-02-01, section 5.2.10 5.2.41 REF: ETP028,059 - V&V Test Plan, Table A- test 3- Filter Particle Capture	ETP028,059-R01_ Validation and Verification Summary Report.	1	3	3	Y
26	**Filter performance**	Stenting or use of other therapeutic tools	Filter damage/ break	Interaction with balloon/ stent Interaction with rotablator Stent overlaps filter area	3	User error: Filter mal-position:	Damaged / broken filter Compromised protection Damage to DES stent- coating.	Procedure complication and elongation	5	15	N	IFU cautions "**WARNING**: Always keep the open Filter Unit distal to the deployed stent. Pulling the Filter Unit into the stent area may lead to entanglement with the stent" In vitro and in-vivo deployment and retrieved through two overlapped stents (DES) at extreme conditions V&V test plan REF: ETP028 - V&V Test Plan, Table A- test 8_Stent Compatibility ETP059 - V&V Test Plan, Table A- test 8_Stent Compatibility Animal study # ATP002, ATP003	IFU - REF: P1-5-0721, under cautions. ETP028, -R01_ETP059 -R01 Validation and Verification Summary Report. ATP002, ATP003-R01_Animal Study report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
26-A	Retrieval catheter insertion over the wire	Before insertion to patient	Catheter insertion failure	Failure to go over the wire	2	User error, physician forgot to remove stylet prior guide wire threading	Retrieval catheter cannot be inserted Retrieval catheter and wire are stuck outside the patient body	Procedure elongation	2	4	A	Design control: Stylet diameter design cannot allow insertion of both guide wire and stylet within the Retrieval catheter retractable tip. In order to thread the Retrieval system over the guide wire the stylet must be removed prior insertion.	Verification and validation. Tests with various guide wires ETP028-R01, ETP059—R01_ Validation and Verification Summary Report	2	2	4	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
27	**Retrieval**	Retrieval catheter tracking	Unable to track catheter to the filter position	Retrieval failure **SP-user mistake**	3	Friction too high. Torturous anatomy Damaged retrieval catheter Damaged wire **SP Retractable soft tip disposition-premature retraction** **Inability to cross stented area**	Unable to retrieve Replace Retrieval Catheter	Procedure elongation Damage to vessel Surgical procedure	5	15	N	Retrieval catheter design: mechanical characteristics, typical crossing profile, nosecone, flexible tip, RX system. Ref: REQ-GEPD-1-02-01, section 5.3.10, 5.3.20,5.3.30, 5.3.40 Validation and verification in tortuous geometries in bench model-comparative study with predicate device REF: ETP028 - V&V Test Plan, Table A- test 1,2 (2D, 3D), 12,13(Torque Testing) **ETP059 - V&V Test Plan, Table A-test 1,2 (2D, 3D)** **ETP060 - V&V Test Plan, Table A -** test 1 -Stent Compatibility, Test 2 -2D simulation , 5 (Torque Testing) Animal Study # ATP002, **ATP003**, ATP004 Validate mechanical strength REF: ETP028 - V&V Test Plan, Table A- test 19 - Tensile Strength **ETP060 - V&V Test Plan, Table A-test 11 - Tensile Strength** REF: ETP106 - Validation and Verification Test Plan	ETP028-R01_ **ETP059 –R01 , ETP060 –R01** Validation and Verification Summary Report. ATP002- **ATP003** R01_Animal Study report R7236-2 Rev.02 Design Verification Test Report ETP106-R01Validation and Verification Summary Report RPT-PC-004 Animal study report rev. 2.0	1	5	5	Y
						SP- premature handle activation	Unable to retrieve	Procedure elongation	3	9	T	**Design activating handle with safety feature to prevent un intended activation** **Ref : REQ-SPRC-002 Gardia Requirements sec 5.1.130** **ETP060 - V&V Test Plan, Table A-test 1,2 (2D, 3D), 11- Animal Trial** **Training and IFU**	**ETP060 –R01 Validation and Verification Summary Report.** **SP IFU: P1-5-0721**	1	3	3	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
28	**Retrieval**	Filter retrieval	Unable to fold the filter	Filter remains open	3	Damaged filter- distorted frame Damaged retrieval catheter – kink or bend **Unable to retrieve SP retractable soft tip**	-Unable to retrieve -Replace Retrieval Catheter -Retrieve partially folded filter	Procedure elongation	3	9	T	Retrieval catheter design: mechanical characteristics, typical crossing profile, nose cone, flexible tip. RX system Validation and verification in tortuous geometries in bench model- comparative study with predicate device REF: ETP028, V&V Test Plan, Table A- test 1, 2, 19 (2D,3D, Tensile Strength) , 12,13(Torque Testing) **ETP059 - V&V Test Plan, Table A- test 1, 2, 19 (2D,3D, Tensile Strength)** **ETP060, V&V Test Plan, Table A- test 1, 2, 11 (2D,3D, Tensile Strength) , 5, 6 (Torque Testing)** Animal Study # ATP002 , **ATP003**, ATP004 REF: ETP106 - Validation and Verification Test Plan	ETP028, **ETP059, ETP060** - R01_ Validation and Verification Summary Report. TR7236-2 Rev.02 Design Verification Test Report ATP002, **ATP003** R01_Animal Study report RPT-PC-004 Animal study report rev. 2.0 ETP106-R01Validation and Verification Summary Report	1	3	3	Y
29	**Retrieval**	Filter retrieval	Debris wash out into blood stream	Retrieval system might tear the filter sac or damage the filter frame during filter folding -Retrieval Catheter failed to fold and retrieve a full filter	3	Retrieval Catheter characteristics e.g. flexibility and dimension are not optimal for safe filter retrieval	Compromised protection	Procedure complication	5	15	N	Retrieval catheter design: mechanical characteristics, low crossing profile, nosecone, flexible tip. Validation and verification In vitro and in animal studies REF: ETP028, **059** - V&V Test Plan, Table A- test 1,2 (2D, 3D), 12,13(Torque Testing) **ETP060, V&V Test Plan, Table A- test 1, 2, 11 (2D,3D, Tensile Strength) , 5, 6 (Torque Testing)** Animal Study # ATP002, **ATP003**, ATP004 REF: ETP106 - Validation and Verification Test Plan	ETP028, **ETP059, ETP060** _ R01 Validation and Verification Summary Report. TR7236-2 Rev.02 Design Verification Test Report ATP002, **ATP003** R01_Animal Study report RPT-PC-004 Animal study report rev. 2.0 ETP106-R01Validation and Verification Summary Report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after m`itigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
30	WIRION system	WIRION system materials	Biocompatibility	Biological interaction e.g. cytotoxicity etc. Bio incompatibility	3	Filter and other material in contact with blood are not biocompatible	- Clots and thrombus formation -Tissue inflammation	Procedure complication and elongation Blood system inflammation	5	15	N	Use biocompatible material Validate biocompatibility according to ISO 10993-1 standard and FDA Blue Book Memorandum #G95-1 Biocompatibility verification for ECO001, ETP059 section 11 Ref: REQ-GEPD-1-02-01, section 5.4.10, 5.4.20 REF: ETP106 - Validation and Verification Test Plan	REF: ScorpioTF011_Biocompatibility summary, and NAMSA reports ETP028- ETP059-R01_ Validation and Verification Summary Report. ETP106-R01Validation and Verification Summary Report Namsa's Summary report and biological risk assessment for the WIRION system project # N132022	1	5	5	Y
			chemical stability	material corrosion	3	weakness mechanical stability / toxicity	Compromised protection Tissue inflammation	Procedure complication and elongation Blood system inflammation	5	15	N	Use resistant material Ref: REQ-GEPD-1-02-01, section 5.4.50 REF: ETP028 - V&V Test Plan, Table A- test # 15- ETP031Corrosion Resistance REF: ETP106 - Validation and Verification Test Plan	ETP028-R01_ Validation and Verification Summary Report. ETP106-R01Validation and Verification Summary Report	1	5	5	Y

#	Process or component	Stage	Safety characteristic	Failure mode	O	Failure cause	Failure local effect	Failure end effect	Risk before mitigation			Mitigation		Risk after mitigation			
									S	rpn 0xS	Acc	Safeguard	Verification	O	S	rpn	Acc
56	Wirion System	During all stages involved	System poor performance	Compromised system performance	2	User error due to Insufficient experience	Compromised system operation	Procedure elongation/surgical intervention/death	5	10	T	Training and IFU	Ref : P1-5-0721 WIRION IFU	1	5	5	Y

Additional manufacturing risks

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
31	**Delivery Catheter Handle**	Incompatibility between parts	Molding	Device can't be assembled	3	2	6	Y	▪ Incoming inspection – dimension (sampling), REF: ICP030, ICP041, ICP042,	1	2	Y
32	**Molding**	Flash problem, sharp corners on handle	Molding & raw materials	Little potential of injury	3	3	9	T	▪ Subcontractor - visual inspection ▪ Incoming inspection – visual, REF: ICP030, ICP041, ICP042, ▪ COC of raw material, REF: ICP030, ICP041, ICP042	1	3	Y
33	**Filter Frame**	Sub-optimal wall apposition	Inappropriate raw material	Filter doesn't deploy appropriately – partial protection against embolism	3	5	15	N	▪ Verification of raw material – COC, COA and Af (raw material) , REF: ICP 025	1	5	Y
34	**Filter Frame**	Sub-optimal wall apposition	Improper Laser cut -wrong dimensions	Filter doesn't deploy appropriately – partial protection against embolism	3	5	15	N	▪ Verification of filter frame cut process – COC ▪ Dimensions Incoming inspection , REF ICP 016	1	5	Y
36	**Filter Frame**	Sub-optimal wall apposition	Inappropriate heat treatment process	Filter doesn't deploy appropriately – partial protection against embolism	3	5	15	N	▪ Visual in- process inspection (100%), REF:SOP 012-RC-01 and SOP 013-RC-01 ▪ Functional inspection (sampling) & AF test after heat treatment (sampling) REF:SOP 012-RC-01 and SOP 013-RC-01	1	5	Y

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
37	**Stopper ring frame welding**	Stopper ring torn from filter frame	Poor welding	Compromised filtration Difficulties to retrieve	3	5	15	N	▪ 100% Visual inspection, REF:SOP 003 RC01 ▪ welding strength testing(sampling), REF SOP 003 RC01	1	5	Y
37C	**Filter balloon production**	Filter balloons shrinks over time in storage (dimension)	Filter balloon production process is not optimal	Reduced yield of balloons cut	5	2	10	T	Phase1: Limit time between balloon production to laser cut	3	5	Y
									Phase 2: Optimize balloon production process to eliminate shrinkage phenomena over time	5	10	T
38	**Filter sac preparation**	Wrong dimensions / variable hole size	Wrong dimensions Poor process	Poor filtration – embolization	3	5	15	N	▪ Verification of dimensions(sampling) and visual final inspection - (subcontractor COT) ▪ Incoming inspection – dimension (sampling), and visual inspection-100%, REF: ICP 014 (for filter balloon raw material) & REF: ICP 023 for filter sac cut.	1	5	Y
39	**Filter sac preparation**	blocked holes: Residuals of cut material on filter sac	Poor cleaning	Compromised flow	3	4	12	T	▪ 100% Visual inspection , REF: ICP 023, filter sac cut	1	4	Y
40	**Activating wire**	Wire broke	Mechanical properties of raw material	Procedure complication and elongation	2	4	8	T	▪ Each lot received with COC and COA (compliance with ASTM F1058) , REF ICP 003 ▪ Incoming inspection – dimension (sampling), REF: ICP 003	1	4	Y
41	**Wedge**	Wrong dimension	Poor grinding	Improper locking	2	4	8	T	▪ Each lot received with COC and COT (100% visual and dimension sampling) REF: ICP 006 ▪ Incoming inspection – dimension (sampling): Dimension inspection – sampling, (Critical-100%), REF: ICP 006	1	4	Y
42	**Wedge**	Wrong material used	Mechanical properties of raw material	Improper locking	2	3	6	T	▪ Each lot received with COA comply with AISI 316L,), REF: ICP 006	1	3	Y
43	**Activating wire wedge assembl**	Weld broke	Improper welding	Improper locking, procedure elongation	3	3	9	T	▪ Subcontractor COC ▪ Incoming inspection - functional + visual (sampling), REF: SOP 007-RC-	1	3	Y

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
									01, ICP018			
44	**Activating wire**	Wedge detached	Poor welding	Procedure complication and elongation	3	3	9	T	Incoming inspection - functional (sampling), REF: SOP 007-RC-01	1	3	Y
45	**Over tube raw material**	Difficulties to deploy filter	Wrong dimensions	Procedure elongation, replace device	3	3	9	T	▪ Subcontractor COC and COT, REF: ICP 033 ▪ Dimensional incoming inspection (sampling) , REF: ICP 033	1	3	Y
46	**Over tube coating**	Difficulties to deploy filter	Inappropriate coating	Procedure elongation, replace device	3	3	9	T	▪ 100% Visual inspection, and dimensio sampling, REF: ICP 028 ▪ Coating verification using dye testing (sampling), REF: ICP 028	1	3	Y
46A	**Guide wire lumen assembly**	Soft tip bond failure	Poor bonding process	Release of soft tip into blood flow, procedure elongation	3	5	15	N	▪ 100% In process visual inspection, In process tensile tests (sampling) REF: ICP052	1	5	Y
47	**Shaft preparation**	Sharp edges	Poor process	Vessel injury	3	5	15	N	▪ 100% Visual inspection, ▪ Delivery Catheter REF: QP 7416 & QP 7416-01 ▪ Retrieval Catheter REF: QP 7417 & QP 7417-01	1	5	Y

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
Supper Pass Retrieval Catheter												
47A	SP Retrieval Catheter Handle Molding	Flash problem, sharp corners on handle	Molding & raw materials	Little potential of injury	3	3	9	T	▪ Subcontractor – visual and dimensional inspection (Sample): ICP063 ▪ Incoming inspection – visual, REF: ICP063 ▪ COC of raw material: ICP063 ▪ SOP51, SP handle assembly functional test	1	3	Y
		Incompatibility between parts	Molding & raw materials	Poor functionality								
47B	SP retrieval tip assembly	Soft tip poor adhesion	Poor process	Soft tip disassemble, procedure elongation	3	5	15	N	▪ Subcontractor COT (AQL) and visual inspection (100%):ICP067 ▪ Subcontractor COC of raw materials: ICP067 ▪ Dimension inspection (sample and 100%) and visual inspection (100%): .ICP067	1	5	Y
47C	SP retrieval tip pull wire assembly	Pull wire poor adhesion, pull wire to handle poor adhesion, Wire –soft tip assembly poor adhesion	Poor process	procedure elongation	3	5	15	N	▪ In process visual inspection (100%): SOP040-RC-01 ▪ In process dimension inspection (100%) :SOP040-RC-01	1	5	Y
48	Shaft preparatio	Parts don't fit	Wrong dimensions	Device can't be assembled	2	1	2	Y	▪ Dimensional in process and final inspection (subcontractor) ▪ Use of jigs ▪ Delivery Catheter REF: QP 7416 & QF 7416-01 ▪ Retrieval Catheter REF: QP 7417 & QF 7417-01	1	2	Y
49	Assembly	Parts disconnected	Poor gluing process	Potential of serious injury	3	5	15	N	▪ Use of jigs ▪ Functional inspection (sampling from each lot) ▪ Delivery Catheter REF: QP 7416 & QF 7416-01 ▪ Retrieval Catheter REF: QP 7417 & QF 7417-01 ▪ Filter Tip Assembly REF: SOP065 & SOP065-RC01. ICP052	1	5	Y

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
50	**Assembly**	Device not operational	Wrong assembly	Procedure elongation, replace device	1	4	4	Y	▪ Use of jigs ▪ 100% Visual inspection ▪ Functional inspection (sampling from each lot) ▪ Delivery Catheter REF: QP 7416 & QF 7416-01 ▪ Retrieval Catheter REF: QP 7417 & QF 7417-01 ▪ Filter Tip Assembly REF: SOP065 & SOP065-RC01, ICP052	1	4	Y
51	**Assembly**	Contaminated device	Environmental, poor hygiene	Inflammatory reaction/ Potential of serious injury to patient.	3	5	15	N	▪ Manufacturing in qualified control environment ▪ Monitoring bioburden levels ▪ Employees training	1	5	Y
52	**Assembly**	Biocompatibility	Residues from the manufacturing process	Inflammatory reaction/ Potential injury to patient	3	5	15	N	▪ Use of process with well established history ▪ Biocompatibility tests were performed on devices manufactured according to actual processes	1	5	Y
53	**Packaging**	Sterile packaging is not sealed properly	Sealing process Raw materials	Inflammatory reaction/ Potential injury to patient	3	5	15	N	▪ Process validation – sealing ▪ Routine maintenance of sealer ▪ 100% Visual inspection ▪ Verification of raw material (COC & COT) ▪ IFU instruct the physician not to use the device if the package integrity is compromised ▪ REF: QP 7418 & QF 7418-01	1	5	Y

#	Process/Part	Failure mode	Failure cause	Failure end effect	Risk before mitigation				Safeguards & Mitigation	Risk after mitigation		
					O	S	RPN	Acc		O	RPN	Acc
54	**Labeling**	Label missing or incorrect	Inadequate adhesive Human error	Inflammatory reaction/ Potential injury to patient (use beyond exp date)	3	5	15	N	• 100% Visual Inspection • Warning in IFU not to use the device if the labels are missing ▪ Packaging validation ▪ REF: QP 7418 & QF 7418-01	1	5	Y
55	**Sterilization**	Device not sterile	Process failure	Inflammatory reaction/ Potential injury to patient	3	5	15	N	▪ Sterilization Validation to SAL 10^{-6} ▪ Parameters control ▪ BI's sterility tests for each lot	1	5	Y

9 Conclusions

9.1 All hazards associated with the use of the WIRION system including single fault conditions, where applicable, have been identified and evaluated.

9.2 A detailed process FMECA was carried out by Creganna, the defined process validations are under implementation. Until completion of all defined activities, only small lots for clinical evaluations will be released following sampling inspection (AQL of 1.5%) including destructive functional inspection.

9.3 The application of risk reduction processes has not introduced any new risks that have not been considered.

9.4 In conclusion, the risk management of the WIRION system is very efficient. The safeguards and verifications described in section 8 above significantly reduce the potential risks to the acceptable level.

9.5 After implementation of the risk mitigations for each potential hazard, it was concluded that the overall risk posed by the device is non-significant and the residual risk is negligible.

9.6 The risk management team concluded that at the current stage the overall potential risk from the device is in an acceptable level and no special action is required.

9.7 Based on the above, it is concluded that the WIRION system benefits outweigh the risks derived from the system usage as an embolic protection system to contain and remove embolic material during cardiovascular interventions.