SUMMARY OF SAFETY AND EFFECTIVENESS DATA (SSED)

I. GENERAL INFORMATION

Device Generic Name: Cardiac ablation percutaneous catheter, intended for treatment of atrial flutter

Device Trade Name: Blazer® Open-Irrigated Ablation Catheter
Maestro 4000™ Cardiac Ablation System
MetriQ™ Irrigation Pump
MetriQ™ Irrigation Tubing Set

Device Procode: OAD

Applicant's Name and Address: Boston Scientific Corporation
Electrophysiology
150 Baytech Drive
San Jose, CA 95134
USA

Date(s) of Panel Recommendation: None

Premarket Approval Application (PMA) Number: P150005

Date of FDA Notice of Approval: February 24, 2016

II. INDICATIONS FOR USE

The Blazer® Open-Irrigated Ablation Catheter, when used with a Maestro 4000 Radiofrequency (RF) Controller and MetriQ Irrigation Pump, is indicated for cardiac electrophysiological mapping, delivering diagnostic pacing stimuli and radiofrequency ablation of sustained or recurrent Type 1 Atrial Flutter in patients age 18 or older.

III. CONTRAINDICATIONS

The Blazer Open-Irrigated Ablation Catheter is contraindicated for use in:

- Patients with active systemic infection;
- Patients with a mechanical prosthetic heart valve through which the catheter must pass;
- Patients unable to receive heparin or an acceptable alternative to achieve adequate anticoagulation;
- Patients who have vena cava embolic protection filter devices and/or known femoral thrombus who require catheter insertion from the femoral approach;
- Patients who are hemodynamically unstable;
- Patients who have myxoma or an intracardiac thrombus;
- Patients who have had a ventriculotomy or atriotomy within the preceding eight weeks.

IV. WARNINGS AND PRECAUTIONS

The warnings and precautions can be found in the Blazer Open-Irrigated Ablation Catheter and the Boston Scientific Open Irrigated System labeling.

V. DEVICE DESCRIPTION

The Blazer Open-Irrigated Ablation Catheter is a 7.5F (2.5 mm) quadrapolar open-irrigated ablation catheter designed to deliver radiofrequency (RF) energy to the 4 mm catheter tip electrode for cardiac ablation. The device is designed to be used in conjunction with the Open-Irrigated System, which is inclusive of the Maestro 4000™ Cardiac Ablation System, MetriQ™ Irrigation Pump, MetriQ™ Irrigation Tubing Set, and associated cables.

The Blazer Open-Irrigated Ablation Catheter incorporates an open-irrigated cooling mechanism through a tip that is partitioned into two chambers. The proximal chamber circulates 0.9% normal saline within the tip to cool the proximal electrode and mitigate overheating while the distal chamber allows the fluid to flow through six irrigation holes into the patient's vasculature, thereby cooling the tip/tissue interface. A Luer connection at the proximal end of the handle connects the catheter to the MetriQ Irrigation Tubing Set, allowing the MetriQ Irrigation Pump to generate the flow of saline to the catheter.

The electrode segment is comprised of a tip electrode and three ring electrodes. The tip electrode has an embedded temperature sensor and delivers radiofrequency (RF) energy for cardiac ablation. The ring electrodes record ECG signals for mapping and deliver stimulus for pacing. The handle includes the electrical connector for the cable connection to the Maestro 4000 RF Generator (Controller) and one Luer fitting used to connect the catheter to the MetriQ Irrigation Tubing Set. The catheter interfaces with standard recording equipment and the Maestro 4000 RF Generator via accessory extension cables with the appropriate connectors.

The Maestro 4000 Cardiac Ablation System (Maestro 4000 Controller and Accessories) is comprised of the Maestro 4000 Cardiac Controller, Maestro 4000 Pod, Maestro 4000 Remote (optional), Maestro 4000 Foot Switch (optional), and dispersive pads (sold separately).

The Maestro 4000 Controller is an RF Generator specifically designed for cardiac ablation. It produces user-selectable power-controlled or temperature-controlled RF power output in the range of 0 to 150 watts into a nominal tissue impedance of 100 ohms. It delivers RF power via a monopolar method driving current between a single active electrode at the tip of the ablation catheter and one or two dispersive pads applied on the skin. When used with the Blazer Open-Irrigated Ablation Catheter, the RF Generator communicates with the MetriQ Irrigation Pump to coordinate delivery of RF energy with irrigation flow to the catheter tip.

The Pod, which is connected to the RF Generator, allows connection to the catheter and provides connections for dispersive pad(s) to complete the RF circuit. The Pod also connects to electrophysiology (EP) recording systems and provides RF filtering to allow continuous electrogram recording during RF delivery. The Pod model determines the maximum power setting allowed by the RF Generator.

The optional Remote allows the user to control the RF Generator with up to 75 feet between the user interface and the sterile field.

The optional Foot Switch provides hands-free control to start/stop RF delivery.

Dispersive pads provide external patient contact to complete the RF circuit. It disperses current over a large area to minimize damage due to heating of skin and underlying tissue.

The MetriQ Irrigation Pump is a peristaltic pump used during RF cardiac ablation interventional procedures. Its purpose is to irrigate the open-irrigated ablation catheter tip electrodes with saline solution by providing a single channel of continuous flow. The MetriQ Irrigation Pump can also be used with an optional MetriQ Foot Switch in Manual Mode to switch between the existing flow rate and the high ablation flow rate.

The MetriQ Irrigation Tubing Set is a sterile, disposable tubing assembly which consists of a drip chamber with intravenous (I.V.) spike for connection to the irrigation source, a peristaltic section that is loaded around the pump head, and a standard Luer fitting for connection to the catheter.

When used in automatic mode, the Maestro 4000 Cardiac Ablation System and the MetriQ Irrigation Pump communicate to coordinate delivery of RF energy and irrigation flow to the catheter tip.

Figure 1 depicts the Blazer Open-Irrigated Ablation Catheter and Figure 2 provides a connectivity diagram showing how the catheter connects to the Maestro 4000 Cardiac Ablation System and the MetriQ Irrigation Pump (known collectively as the Boston Scientific Open-Irrigated System).

Figure 1: Blazer Open-Irrigated Ablation Catheter

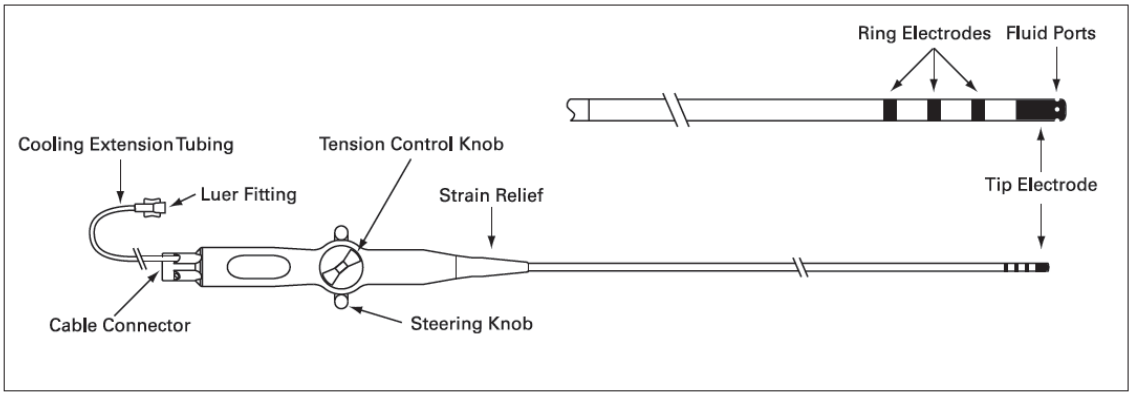
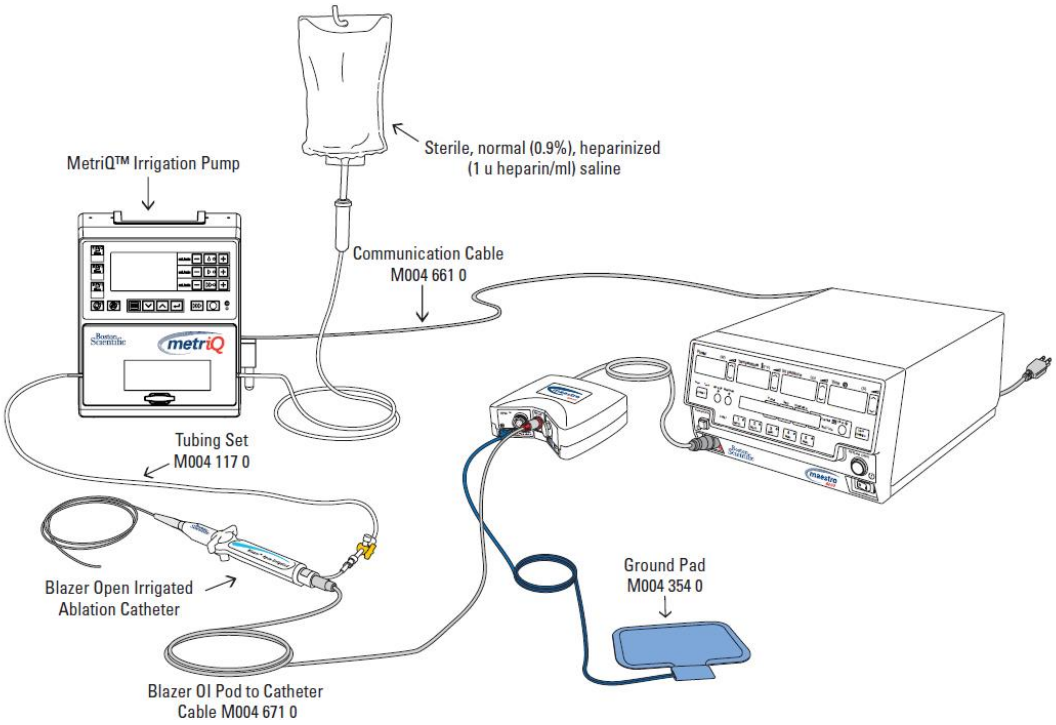


Figure 2: Blazer Open-Irrigated Ablation Catheter Interconnections with the Maestro 4000 Cardiac Ablation System and MetriQ Irrigation Pump



The Remote and Pump Cables (non-sterile), EGM Cable (non-sterile), and Catheter Cable (sterile) are sold separately by Boston Scientific.

VI. ALTERNATIVE PRACTICES AND PROCEDURES

There are several other alternatives for the correction of type I atrial flutter, including ablation with another commercially available ablation catheter, pharmacological therapy for rate and/or rhythm control, cardioversion, AV nodal ablation with permanent pacemaker implantation, and surgery. Each alternative has its own advantages and disadvantages. A patient should fully discuss these alternatives with his/her physician to select the method that best meets expectations and lifestyle.

VII. MARKETING HISTORY

The Blazer Open-Irrigated Ablation Catheter is marketed in the following regions or countries: European Union, Canada, Iran, Israel, Iceland, Asia, Liechtenstein, Macau, Russia, and Central and South America.

The Maestro 4000 Cardiac Ablation System is marketed in the United States and the European Union. The MetriQ Irrigation Pump and MetriQ Tubing Set are both marketed in the European Union.

There are no countries from which the Blazer Open-Irrigated Ablation Catheter or the Boston Scientific Open-Irrigated System has been withdrawn from marketing for any reason related to safety and effectiveness.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Below is a list of the potential adverse effects (e.g., complications) associated with the use of the device.

- allergic reaction (including anaphylaxis)
- angina
- arrhythmias (new or exacerbation of existing arrhythmias)
- arterial-venous fistula
- cardiac perforation
- cardiac/respiratory arrest
- catheter entrapment
- cerebrovascular accident (CVA)
- chest discomfort
- conduction pathway injury
- complete heart block (transient/permanent)
- complications of sedative agents/anesthesia
- congestive heart failure
- death
- effusion (pericardial/pleural)
- embolism (venous/arterial) (i.e., air embolism, cerebrovascular accident, myocardial infarction, pulmonary embolism)
- fluid volume overload
- hematoma
- hemorrhage
- hypertension
- hypotension
- infection
- lead dislodgement
- myocardial infarction
- nerve injury (phrenic/vagus)

• pericarditis
• pleuritis
• pneumothorax
• pseudoaneurysm
• pulmonary/pedal edema
• radiation exposure
• renal insufficiency/failure
• skin burns (radiation/defibrillator/cardioverter)
• tamponade
• transient ischemic attack (TIA)
• thrombosis
• valvular damage
• vasospasm
• vasovagal reactions
• vessel trauma (perforation/dissection/rupture)

For the specific adverse events that occurred in the clinical studies, please see Section X below.

IX. SUMMARY OF PRECLINICAL STUDIES

Pre-clinical testing of the Blazer Open-Irrigated Ablation Catheter included verification and validation testing (device, system, and software), biocompatibility of patient-contacting materials, sterilization, packaging and shelf life testing, and animal studies. Performance testing was conducted to demonstrate design integrity. Tests that were identified in standards or guidance documents were performed based on product specification requirements. The following summarized testing was done on devices representative of proposed commercial devices manufactured by trained operators. 'Pass' denotes the devices and systems met established product specification and/or performance criteria, or were in conformance with the requirements of the standards tested to. Test results confirmed the Blazer Open-Irrigated Ablation Catheter, Maestro 4000, and MetriQ Irrigation Pump and Tubing Set met product specifications.

A. Laboratory Studies

In Vitro Bench Studies

Blazer Open-Irrigated Ablation Catheter passed design verification (functional) bench testing including dimensional, strength, reliability, mechanical, and electrical integrity. Testing included performance of the Maestro 4000 used in conjunction with the Blazer Open-Irrigated Ablation Catheter and all other System components (BSC Open-Irrigated (OI) System design verification).

Table 1 summarizes the design verification (functional) bench testing completed for the Blazer Open-Irrigated Ablation. **Table 2** provides a summary the BSC OI System design verification.

In addition to testing summarized here, design verification was successfully completed for the Blazer Open-Irrigated to Maestro 4000 Pod Cable (Cable 671) and individual components of the BSC OI System: Maestro Controller and Accessories, MetriQ Irrigating Pump, and MetriQ Irrigation Tubing Set. The Blazer Open-Irrigated Ablation Catheter and the BSC OI System also passed testing that demonstrates compliance to Medical Electrical Equipment Standards.[1]

Table 1: Blazer Open-Irrigated Ablation Catheter Design Verification (Functional) Testing

Test	Acceptance Criteria	Result
Dimensional: Effective Catheter Length, Distal Length, Shaft Size, Electrode Spacing, Curve Profile	All physical dimensions identified in the product specification must be met.	Pass
Strength: Tip Electrode to Catheter Body	Tip Electrode to Catheter Body: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Tip Electrode to Catheter Body	Tip Electrode to Catheter Body: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Distal Tubing to Main Body Tubing	Distal Tubing to Main Body tubing: Tensile force ≥ 22 N (5.0 lbf)	Pass
Strength: Main Body Tubing to Handle	Main Body Tubing to Handle: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Steering Knob to Handle	Steering Knob to Handle: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Handle Top to Handle Bottom	Handle Top to Handle Bottom: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Strain Relief to Handle	Strain Relief to Handle: Tensile Force ≥ 10. N (2.2 lbf)	Pass
Strength: Cooling Extension Tubing to Handle	Cooling Extension Tubing to Handle: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Strength: Luer Fitting to Cooling Extension Tubing	Luer Fitting to Cooling Extension Tubing: Tensile Force ≥ 22 N (5.0 lbf)	Pass
Steering Mechanism Actuation	Catheter has bidirectional steering and conforms to curve profile template in Section 6.1.5 of Product Specification (curve profiles)	Pass

	Tip does not move when the tension control knob is set to the '+' lock position.	Pass
Torque Transmission of the Catheter Body	Torsional Rigidity (GJ value) > 5.72 x 10^{-5} N-m^2/rad (0.319 ozf•in^2/rad) when gauge length of 28 cm (11 in) is used	Pass
Bending Stiffness	Stiffness of distal shaft < 22.7 kgf•cm^2 (7.76 lbf•in^2)	Pass
Distal Buckling	Average force required to buckle distal section ≤ 340 g (0.75 lbf) when catheter is gripped 5.0 cm (2.0 in) from tip and buckling force is applied perpendicular to tip	Pass
Twisting – Electrical: Tip, Ring, Wire-to-wire Resistance	After two 360° twist rotations: From connector to ring wire: R < 10 Ω From connector to tip wire: R < 5 Ω Between any two separate wires (wire-to-wire): R > 1 MΩ	Pass
Twisting – Electrical: Thermocouple resistance	After two 360° twist rotations: R < 350 Ω	Pass
Twisting - Mechanical	After five additional 360° twist rotations (totaling 7 rotations): There is no physical or mechanical failure (external components only)	Pass
Corrosion	The catheter shall not exhibit any corrosion when tested in accordance the ISO 10555-1.	Pass
Temperature: Accuracy (Sensing without Cooling Fluid)	Temperature accuracy is ± 5°C at 37°C and +3°C/-5°C at 95°C within 8 s	Pass
Cooling Flow: Cooling Efficacy	Minimum decrease in tip temperature is 20°C within 10 s when tip is placed in 95°C bath and room temperature saline is used	Pass
Cooling Flow: Maximum Head Pressure	Maximum head pressure is 517 kPa (75.0 psig) at 60 ml/min	Pass
RF Power Transmission Capacity	The catheter with cable shall be able to deliver/transmit RF power equal to 50 W with an impedance of 50 Ω and not exceed a maximum current of 1 A_{rms}.	Pass
RF Leakage Current	The catheter with cable shall pass the ANSI/AAMI HF 18 RF leakage current	Pass

	test, which specifies 800 V_{p-p} and 1 MHz. Maximum allowable current of 3.6d mA_{rms} per cm of catheter length. If the test is performed at 300 V_{p-p} and 500 kHz, the maximum allowable current is 0.675d mA_{rms} per cm, where d = catheter diameter (mm).	
Voltage	Catheter with cable shall withstand an operating voltage of ≥ 200 V_{p-p} when measured from the tip to the return pad.	Pass
High-Frequency Dielectric Strength	The dielectric strength shall withstand 120% of the maximum output voltage of the generator for the catheter being tested.	Pass
Mains-Frequency Dielectric Breakdown Voltage	The dielectric breakdown voltage wire to wire shall be > 299 V_{rms}. The DC wire-to-wire resistance shall be > 1 MΩ between resistance associated with a separate electrical circuit.	Pass
Power	The catheter with cable shall withstand an operating power of 50 W.	Pass
Resistance	The resistance shall be: Catheters testing from electrode to thermocouple DC resistance > 1 MΩ	Pass
	The resistance shall be: Between RF ablation electrodes and associated lead wires DC resistance ≤ 5 Ω	Pass
	The resistance shall be: Between ring electrode and associated lead wires DC resistance < 10 Ω	Pass
	The resistance shall be: wire to wire (short testing) DC resistance > 1 MΩ	Pass
	The resistance shall be: T-type thermocouple Resistance < 350 Ω at room temperature	Pass
Capacitance	Capacitive coupling between electrode pairs at 1 kHz and 1 V shall be less than 1600 pF.	Pass
Noise	Average readings for electro gram noise during RF shall be < 142 μV_{p-p} for 10 s with the cooling flow on.	Pass

RF Functionality	The catheter with cable shall operate the Stockert 70 RF generator at 50 W, at the appropriate flow rate, for 60 seconds, without the generator reaching temperature shutoff.	Pass
Steering Life Cycle: Curve Degradation	When catheter is returned to straight, deflected curve does not degrade more than 30° when compared to initial deflection	Pass
Steering Life Cycle: Mechanical Integrity	At end of 100 cycles, catheter does not exhibit any bond failures, component malfunctions, or separations from catheter body	Pass
Steering Life Cycle: Electrical Integrity	When catheter is returned to straight: Catheter does not exhibit any electrical opens or shorts Ring electrode to signal wire resistance < 10 Ω RF wire resistance < 10 Ω	Pass
Steering Life Cycle: Electrical Integrity	When catheter is returned to straight: Thermocouple resistance < 350 Ω	Pass
Steering Life Cycle: Head/Holding Pressure Integrity	Catheter shall hold 690–758 kPa (100–110 psi) for at least 10 seconds with ΔP ≤ 28 kPa (4 psi) when the irrigation holes are plugged	Pass
Steering Life Cycle: Flow Rate Integrity	Catheter shall infuse 30 ml ± 5 ml per minute using a CoolFlow pump or similar set at a flow rate of 30 ml/min	Pass
Introduction/ withdrawal - Mechanical	At end of 5 Cycles: There are no mechanical failures such as bending, bond delamination, electrode movement, or adhesive dislodgment	Pass
Introduction/ withdrawal - Electrical	The catheter shall withstand 5 introduction and withdrawal cycles using a commercially available 8-F (2.67 mm) introducer sheath and at the end of 5 introduction/withdrawal cycles, there shall be At end of 5 Cycles: Catheter does not exhibit any electrical opens or shorts Ring electrode to signal wire resistance < 10 Ω	Pass

	RF wire resistance < 10 Ω	
	At end of 5 Cycles: Thermocouple resistance < 350 Ω	Pass
Connector System: Insertion/ Extraction Force	After a minimum of 20 engagement and disengagement cycles: Insertion/extraction force is 12–39 N (2.6–8.8 lb)	Pass
Connector System - Electrical	At end of 20 Engagement/Disengagement Cycles: There are no electrical opens/shorts There are no ring-electrode-to-signal-wire resistance values ≥ 10 Ω RF Wire Resistance < 10 Ω	Pass
	At end of 20 Engagement/Disengagement Cycles: Thermocouple Resistance < 350 Ω	Pass
Safety: Catheter Body Heating	Outer surface of catheter body does not exceed 41°C (111.2°F) after ablating for 120 s at 50 W when located in a 37°C (98.6°F) saline solution bath	Pass
Luer Lock	The catheter connection shall have a standard female luer lock fitting (conical fitting with 6% taper for syringes, needles, and other medical equipment), which shall conform to EN 1707 and EN 20594-1, or ISO 594-2, on the pre-sterile component.	Pass
S-Curve	Catheter withstands 3 cycles through a 120° curve, 8.5- F sheath without the presence of an S-shaped curve in the distal section.	Pass

Table 2: BSC Open-Irrigated System Design Verification (Functional) Testing

Test	Acceptance Criteria	Result
Non-Periodic EGM Noise	The Maestro 4000, in conjunction with the MetriQ Irrigation Pump, OI catheter, and MetriQ Irrigation Tubing Set, shall contribute an average EGM noise amplitude of no more than 142 microvolts peak-to-peak, while delivering 20 watts and 17 mL/min.	Pass
Periodic EGM Noise	The Maestro 4000, in conjunction with the MetriQ Irrigation Pump, OI catheter, and	Pass

	MetriQ Irrigation Tubing Set, shall contribute an average EGM noise amplitude of no more than 71 microvolts peak-to-peak within the periodic rate of 333 to 1,500 milliseconds, at a flow rate of 30 mL/min.	
Temperature-Control Mode Accuracy	In the DELIVER state, with the temperature-control mode selected, the Maestro-4000-measured temperature shall reach and remain within -3% -2°C to +3% +2°C of the temperature setting in the absence of an operational message.	Pass
Power-Control Mode Accuracy	In the DELIVER state, with power-control mode selected, the Maestro-4000-measured power shall reach and remain within -5% -2 W to +5% +2 W of the power setting in the absence of an operational message.	Pass
Inject real bubble	Inject real bubble Pump displays "P01-BUBBLE DETECTED" Pump stops flow Generator displays "D12-CHECK PUMP" Generator stops RF.	Pass
Pump stops flow	Pump displays "P01-BUBBLE DETECTED" Pump stops flow Generator displays "D12-CHECK PUMP" Generator stops RF.	Pass
Generator displays "D12- CHECK PUMP"	Pump displays "P01-BUBBLE DETECTED" Pump stops flow Generator displays "D12-CHECK PUMP" Generator stops RF	Pass

Software Validation

The Maestro 4000 Controller and Accessories (Maestro 4000) firmware (Version 5.14) and the MetriQ Irrigation Pump System (MetriQ Pump) firmware (Version 0.0.64) have primary responsibility for the operator interface, procedure settings, control of RF power for the Maestro 4000, and saline irrigation for the MetriQ Pump. The MetriQ Pump firmware also communicates with the Maestro 4000 Controller to react to the ablation state of the controller (generator). The generator computes and displays data related to its operation and the procedure and interfaces with all other peripheral equipment.

Firmware testing included a full suite of safety and performance tests. The firmware was evaluated through unit, integration, verification and validation testing to demonstrate that the performance and safety of the Maestro 4000 and the MetriQ Irrigation Pump conform to specifications.

Biocompatibility

Biocompatibility testing of the Blazer Open-Irrigated Ablation Catheter and the MetriQ Irrigation Tubing Set was conducted in accordance with ISO 10993-1:2009 – Biological evaluation of medical devices – Part 1, and FDA/CDRH/ODE Blue Book Memorandum G95-1, Use of International Standard ISO-10993.

Catheter test samples were representative of the Blazer Open-Irrigated Ablation Catheter family of devices in materials, processing, and packaging. The catheter is classified according to ISO 10993-1 as follows:

• Category: Externally Communicating
• Contact Duration: < 24 hours (Limited)
• Device Body Contact: Circulating Blood Path

A summary of the results are reported in **Table 3** and demonstrate that the Blazer Open-Irrigated Ablation Catheter is biocompatible as per ISO 10993-1. These test results provide objective evidence that the Blazer Open-Irrigated Ablation Catheter is biocompatible for its intended use. In addition, the Blazer Open-Irrigated Ablation Catheter contains no detectable latex.

Table 3: Biocompatibility Test Summary – Blazer Open-Irrigated Ablation Catheter

Test Performed / Applicable ISO 10993 Part No.	**Results**
MEM Elution Cytotoxicity/Part 5	Pass
Guinea Pig Maximization Sensitization/Part 10	Pass
Intracutaneous Reactivity/Part 10	Pass
Acute Systemic Injection/Part 11	Pass
Materials Mediated Rabbit Pyrogen/Part 11	Pass
Hemolysis Direct Contact/Part 4	Pass
Hemolysis Extract Method/Part 4	Pass
Partial Thromboplastin Time /Part 4	Pass
In Vitro Hemocompatibility Assay/Part 4	Results comparable to Reference Control
Complement Activation/Part 4	Negative for C3a Assay Negative for SC5b-9 Assay
In Vivo Thromboresistance Study in Dogs / Part 4	Test and Control articles were thromboresistant
USP Physicochemical <661>	Pass
Fourier Transform Infrared Analysis (FTIR/Infrared Spectroscopy)	Baseline Chemical Analysis
Natural Rubber Latex ELISA Inhibition Assay for Antigenic Protein ASTM D6499	Below level of detection

Patient contacting materials of the Blazer Open-Irrigated Ablation Catheter are listed in **Table 4**.

Table 4: Blazer Open-Irrigated Ablation Catheter Blood/Fluid Contact Components and Materials

Component / Material Name	Chemical Name/ Formulation/Grade
Tip Electrode	Platinum/Iridium (90/10)
Distal Insert	303 Stainless steel Nickel Chromium Iron Silicon Manganese Carbon Phosphorus Sulfur
Solder	Tin/Silver (95/5)
Thermocouple	303 Stainless Steel Iron Nickel Manganese Chromium Copper Polyimide TRA-Bond 931-1
Proximal Tip Insert	303 Stainless Steel Iron Manganese Molybdenum Nickel Silicon Titanium Carbon Chromium Cobalt Copper Sulfur Phosphorus
Dual Taper Cooling Lumen	Pebax 7233 BaSO4 TiPure R101 TiO2 Phthalo Green Phthalo Blue 15:1 Channel Black Myverol 18-06PK
Ring Electrode	Platinum/Iridium (90/10) Iridium Iron

	Palladium Platinum Rhodium Samarium Silver Titanium Tungsten Boron Chromium Cobalt Gold Zirconium
Distal Tubing	Pellethane 2362-80AE BaSO4 4518 Tipure R101 TiO2 Carbon Black Raven 22
Nylon Lined Braided Shaft	Polymer tubing: Pebax 7233 (72 ± 3 duro) Pantone (6C–8C), cool gray 20% ± 5% BaSO4 radiopaque filler Wire braid: 304 SS
Loctite 4305	Ethyl 2-cyanoacrylate
TRA-Bond	1. Phenol, 4,4'−(1−methylethylidene)bis−, polymer with 2−(chloromethyl)oxirane 2. Poly[oxy(methyl-1,2-ethanediyl)], .alpha.-(2-aminomethylethyl)- omega.-(2 aminomethylethoxy)-
Adhesive, 2-part	Polycin 936
Adhesive, 2-part	Vorite 689
Proximal Extension Tubing	Tygon, formulation S-54-HL, Shore A, 83 containing DEHP
Cooling Luer Fittings	1. Carbonic dichloride, polymer with 4,4'−(1−methylethylidene)bis[phenol], 4−(1,1−dimethylethyl)phenyl ester1 2. Regulatory Decision File
Steering Assembly Center Support	UNS S1700 Sheet Stock

MetriQ Irrigation Tubing Set test samples were derived from finished product. The tubing set is classified according to ISO 10993-1 as follows:

- Category: Externally Communicating
- Contact Duration: < 24 hours (Limited)
- Device Body Contact: Blood Path Indirect

A summary of the results are reported in **Table 5** and demonstrate that the MetriQ Tubing Set is biocompatible as per ISO 10993. These test results provide objective

evidence that the MetriQ Irrigation Tubing Set is biocompatible for its intended use. In addition, the MetriQ Irrigation Tubing Set contains no detectable latex.

Table 5: Biocompatibility Test Summary – MetriQ Irrigation Tubing Set

Test Performed / Applicable ISO 10993 Part No.	**Results**
MEM Elution Cytotoxicity/Part 5	Pass
Guinea Pig Maximization Sensitization/Part 10	Pass
Intracutaneous Reactivity/Part 10	Pass
Acute Systemic Injection/Part 11	Pass
Materials Mediated Rabbit Pyrogen/Part 11	Pass
Ames Mutagenicity/Part 3	Pass
Hemolysis Extract Method/Part 4	Pass
Partial Thromboplastin Time /Part 4	Pass
In Vitro Hemocompatibility Assay/Part 4	Results comparable to reference control
USP Physicochemical <661>	Pass
Natural Rubber Latex ELISA Inhibition Assay for Antigenic Protein ASTM D6499	Below level of detection
Assessment of TOTM and DEHA Leachable Amounts	Pass

Indirect blood contacting materials for the MetriQ Irrigation Tubing Set are listed in **Table 6**.

Table 6: Indirect Blood Contacting Materials List for the MetriQ Irrigation Tubing Set

Component / Material Name	**Chemical Name/ Formulation/Grade**
Adhesive, Loctite 3021	2-Propenoic acid, 2-methyl-,2-[[2,3,3a,4,7,7a (or 3a, 4,5,6,7,7a)- hexahydro-4,7-methano-1H-indenyl]oxy] ethyl ester (30-40%) Polyurethane Methacrylate Resin (20-30%) High Boiling methacrylate (5-10%) Acrylica acid (3-7%) 2-Hydroxyethyl methacrylate (3-7%) Photoinitiator (3-7%) Gamma-glycidoxypropyl trimethoxysilane (1-3%) Hydroxyalkyl methacrylate (1-3%) Ester Adducts (.2-1%) Ethylene glycol (.1-1%)
Spike/Chamber assembly with cap	Chamber: Polyproplene/Styrene-ethylene-butylene-styrene (% proprietary) Spike: Acrylonitrile butadiene styrene (% proprietary) Cap: Polyethylene (% proprietary)
Male Luer Lock	2-Propenoic acid, 2-methyl, methyl ester, polymer with 1,3- butadiene, ethenylbenzene and 2-propenenitrile
Tygon Non-DHEP	Polyvinyl Chloride – 25-75 %

Tubing (1/8" OD X 1/16" ID), ND-100-65	Dioctyl adipate – 10-60% Stabilizers and colorants - % proprietary
Tygon Non-DEHP Tubing (1/8" ID X 1/4" OD), S-22-216	Polyvinyl Chloride – 25-75 % Dioctyl adipate – 10-60% Stabilizers and colorants - % proprietary
Stopcock	Body and collar: Polycarbonate (98% min) Handle: Polyethylene (90-100%) White Colorant: Titanium Dioxide (% proprietary) Zinc Stearate (% proprietary) Ethene, homopolymer (% proprietary)

B. Animal Studies

A total of four acute and chronic Good Clinical Practice (GLP) *in vivo* animal studies were conducted to support a right atrial flutter indication with the Blazer Open-Irrigated Ablation Catheter.

Three of the four studies were conducted using the Blazer Open-Irrigated Ablation Catheter in conjunction with the Blazer Open-Irrigated Ablation Catheter Cable, Stockert 70 Radiofrequency (RF) Generator, Biosense Webster CoolFlow Irrigation Pump, and Biosense Webster CoolFlow Irrigation Tubing Set (Surrogate System). Of these, two studies were GLP safety studies and one was a GLP design validation study.

The fourth GLP study was conducted to demonstrate the safety and performance of the Blazer Open-Irrigated Ablation Catheter when used in conjunction with the Maestro 4000 RF Generator and MetriQ Irrigation Pump in comparison to the Biosense Webster Stockert RF Generator and Biosense Webster CoolFlow Irrigation Pump (Surrogate System).

Results of these studies demonstrated that the Blazer Open-Irrigated Ablation Catheter, when used at the upper limit of anticipated clinical operating range, successfully and safely delivered RF energy to targeted endocardial locations in canine tissue. Ablation sites included the cavo tricuspid isthmus (CTI) and intercaval isthmus (ICI) with ablation performed for varying ablation durations. In addition, design validation demonstrated that the Blazer Open-Irrigated Ablation Catheter conformed to user needs and intended use as defined by marketing specifications. Taken together, the safety and satisfactory performance of the Blazer Open-Irrigated Ablation Catheter was demonstrated when used in conjunction with the Maestro 4000/MetriQ System in comparison to the Stockert/CoolFlow System. No device-related deaths, major complications or adverse events were observed during the study procedure or during the follow-up in-life period in any of the studies.

Table 7: GLP Animal Testing for the Blazer Open-Irrigated Ablation Catheter

Animal Model	Procedure	Number of Animals
Canine	Chronic	15
Canine	Chronic	3
Canine	Acute	1
Canine	Chronic	12

In addition to the *in vivo* GLP safety and design validation studies, a canine thigh prep study was conducted to demonstrate equivalent performance on safety and lesion outcomes between the Maestro 4000/MetriQ and Stockert 70/CoolFlow RF Generator/Irrigation Pump Systems when performing RF ablations using the Blazer Open-Irrigated Ablation Catheter. This study was conducted as a randomized controlled study using the methodology of Nakagawa et al. (i.e., Circulation 1995, 91: 2264-2273 and Circulation 1998, 98: 458-465).[2] A series of RF ablations were performed for 60 seconds each using representative RF ablation power (low/high) and catheter tip orientation (parallel/perpendicular) conditions as outlined in **Table 8**.

Table 8: Study Group Design for Maestro 4000 vs. Stockert 70 Canine Thigh Prep Study

Generator	**Power (W)/ Flow Rate (mL/min)**	**Catheter Orientation**	**Lesion Number**
Stockert 70	25/17	Parallel	12
	25/17	Perpendicular	12
Maestro 4000	25/17	Parallel	12
	25/17	Perpendicular	12
Stockert 70	40/30	Parallel	12
	40/30	Perpendicular	12
Maestro 4000	40/30	Parallel	12
	40/30	Perpendicular	12

Results of these studies demonstrated that the Maestro 4000 and Stockert 70 Generators produced clinically equivalent lesions across all experimental conditions when comparing lesion volume and lesion dimensions (maximum lesion depth and maximum lesion diameter) and when comparing safety endpoints such as incidence of steam pop and incidence of thrombus/coagulum/char on the catheter tip following RF ablation.

Taken together, the results of the Thigh Prep study along with the engineering testing support the equivalence of the Maestro 4000 Generator to the Stockert 70 Generator for catheter ablation of type 1 atrial flutter (AFL), and thus the results of the BLOCk-CTI study may be extrapolated to the use of the Blazer Open-Irrigation Ablation Catheter with the Maestro 4000 Generator.

C. Additional Studies

Sterilization, Packaging, and Shelf Life

The Blazer Open-Irrigated Ablation Catheter and the MetriQ Irrigation Tubing Set (subject products) are supplied sterile, single use, and ready to use. The Blazer Open-Irrigated to Maestro 4000 Pod Cable is supplied sterile and may be reprocessed up to ten times within the self-life of the device. The subject products are sterilized via 100% ethylene oxide (EO) at qualified sterilization facilities using a validated sterilization cycle. The sterilization process validation was conducted to provide a sterility assurance level (SAL) of at least 10^{-6} in accordance with ISO 11135-1:2007, a recognized standard for EO terminally sterilized medical devices. Adoption of the subject products into the validated cycle is supported by successful completion of the following sterility and microbiological tests: inoculated product vs. Process Challenge Device (PCD); natural product sterility; bacteriostasis and fungistasis; and ethylene oxide residuals. Sterile devices meet the ISO allowable limits for sterilant gas residuals as set forth in ISO 10998-7, Biological Evaluation of Medical Devices – Part 7: Ethylene oxide sterilization residuals.

The Maestro 4000 and MetriQ Irrigation Pump are not sterile, are reuseable, and are placed in the non-sterile field during the procedure.

The catheter is packaged in thermoform tray with indentations and notches that hold it in place and provide protection during shipment. The tray is placed in a Tyvek®/Nylon pouch and sealed to provide a single sterile barrier. The devices along with directions for use (DFU) are placed in a carton designed to further protect the catheter during transport, handling, and storage.

The Blazer Open-Irrigated to Maestro 4000 Pod Cable is packaged individually in a Tyvek/nylon pouch to maintain a single sterile barrier. The sealed and labeled pouch is placed with the DFU into a carton to protect the device and pouch.

The MetriQ Irrigation Tubing Set is wound up into a coil and held by twist ties. The assembly is placed inside a Tyvek/nylon pouch to provide a single sterile barrier. The sealed and labeled pouch and the DFU are placed in a carton.

Testing was performed to verify that the Blazer Open-Irrigated Ablation Catheter, MetriQ Irrigation Tubing Set and sterile cable can meet the required performance specifications, user interface and labeling requirements after being exposed to 2X sterilization, as well as distribution challenge. In some cases, actual testing was not performed, but rather testing was leveraged from an Electrophysiology device that is physically equivalent, and/or exceeds the physical characteristics of the subject device.

The Maestro 4000 and MetriQ Pump underwent packaging qualification to verify the packaging system for these two components can withstand shipping and distribution environment conditioning.

Expiration dating for the Blazer Open-Irrigated Ablation Catheter and Blazer Open-Irrigated to Maestro 4000 Pod Cable is 3 years. The MetriQ Irrigation Tubing Set supports a shelf life labeling of 1 year based on successful aging studies that included accelerated aging. Real time aging studies to substantiate results using accelerated aging have either been completed or are in progress.

Maestro 4000 versus Stockert 70 Radiofrequency Generator

The clinical study was performed with the Blazer Open-Irrigated Ablation Catheter with the Stockert 70 RF generator; however, the device is approved for use with the Maestro 4000 RF generator. The submission included bench comparisons of the waveform frequency, maximum temperature, temperature accuracy, time accuracy, maximum time, maximum impedance range, minimum impedance range, and impedance accuracy between the two generators to support equivalency in clinical use with the Blazer Open-Irrigated Ablation Catheter. However, differences of greater than 5% were identified for the power output and power accuracy between the two generators. Approval of the Maestro 4000 RF generator under this PMA was supported by additional preclinical animal study data which demonstrated clinically equivalent lesions with the Blazer Open-Irrigated Ablation Catheter using the Stockert 70 RF and Maestro 4000 RF generators.

MetriQ versus CoolFlow Irrigation Pump

The clinical study was performed with the Blazer Open-Irrigated Ablation Catheter with the CoolFlow Irrigation Pump; however, the device is approved for use with the MetriQ Irrigation Pump. Bench test comparisons of the specifications, flow rates, and safety features between the two pumps were submitted to demonstrate expected equivalent clinical performance with the Blazer Open-Irrigated Ablation Catheter.

X. SUMMARY OF PRIMARY CLINICAL STUDY

The applicant performed a clinical study (BLOCk-CTI) to establish a reasonable assurance of safety and effectiveness of catheter ablation with the Blazer Open-Irrigated Ablation Catheter for the treatment of type I Atrial Flutter (AFL) in the US under IDE # G100099. The clinical study was performed using the Blazer Open-Irrigated Ablation Catheter with the Stockert 70 RF generator and Coolflow Irrigation Pump.

Data from the BLOCk-CTI study were the basis for the PMA approval decision. A summary of the clinical study is presented below.

A. Objective

The objective of the study was to demonstrate that the safety and effectiveness of the Blazer Open-Irrigated Investigational Catheter is non-inferior to that of the Control Catheters when being used to ablate the cavo-tricuspid isthmus for the treatment of sustained or recurrent type 1 AFL. There were no sub-studies conducted.

B. Study Design

BLOCk-CTI (Blazer Open-Irrigated Radiofrequency Catheter for the Treatment of Type 1 Atrial Flutter) was a prospective, randomized, controlled, single-blinded, multi-center U.S. investigation. In this study, the Control devices were open-irrigated radiofrequency (RF) ablation catheters that received FDA market-approval for the treatment of type 1 atrial flutter and the Investigational device was the Blazer Open-Irrigated Ablation Catheter. A commercially available radiofrequency generator (Stockert 70), Irrigation Pump and the Coolflow Tubing Kit were used in the study.

Patients were treated between January 17, 2011 and January 15, 2014. The database for this PMA reflected data collected through January 15, 2014 and included 302 patients. There were 24 investigational sites.

All adverse events and deaths reported in this study were reviewed and adjudicated by an Ablation Clinical Events Committee (CEC). The CEC was comprised of independent physicians, and its decisions were based upon independent physician review of data.

1. Clinical Inclusion and Exclusion Criteria

Enrollment in the BLOCk-CTI study was limited to patients who met the following inclusion criteria

- At least one (1) documented episode of type 1 atrial flutter in the 180 days (6 months) preceding enrollment documented by 12-lead ECG, Holter monitor, rhythm strip, or trans-telephonic monitor.
- Subjects are clinically indicated for catheter ablation.
- Subjects receiving oral anti-arrhythmic drug (AAD) therapy (class I or class III) for a tachyarrhythmia other than type 1 atrial flutter must be controlled on the AAD for a minimum of 30 days prior to enrollment. If type 1 atrial flutter was documented prior to the development of other tachyarrhythmias, this 30-day period is not required.
- Age 18 or above, or of legal age to give informed consent specific to state and national law.
- Subjects are competent and willing to provide written informed consent to participate in the study and agree to comply with follow-up visits and evaluation

Patients were not permitted to enroll in the BLOCk-CTI study if they met any of the following exclusion criteria:

- Any prior right atrial cavo-tricuspid isthmus (CTI) ablation or any cardiac ablation for non-atrial flutter arrhythmias within 90 days prior to enrollment
- Cardiac surgery within 90 days prior to enrollment
- Myocardial infarction (MI) within 60 days prior to enrollment
- Current unstable angina
- Subjects who cannot have anti-arrhythmic drugs (AADs, class I and class III) prescribed for the treatment of type 1 atrial flutter stopped on the day of the procedure
- Subjects regularly prescribed amiodarone within the 120 days (4 months) prior to enrollment
- Documented atrial or ventricular tumors, clots, thrombus, or have a known clotting disorder within 90 days prior to enrollment
- Implantation of permanent leads of an implantable device in or through the right atrium within 90 days prior to enrollment.
- Direct remedial cause of atrial flutter (e.g. thyroid disease, pericarditis, pulmonary embolic disease)
- Atypical or scar-based flutter
- Subjects with New York Heart Association (NYHA) Class III at the time of enrollment or NYHA Class IV heart failure within 90 days prior to enrollment
- Subjects with an ejection fraction <30% within 90 days prior to enrollment
- Clinically significant structural heart disease, (including tricuspid valve regurgitation, tricuspid valve stenosis, tricuspid valve replacement, Ebstein's anomaly, or other congenital heart disease) that would preclude catheter introduction and placement, as determined by the Investigator
- Any cerebral ischemic event (including transient ischemic attacks) within 180 days prior to enrollment
- Contraindication to anticoagulation therapy based upon published guidelines
- Creatinine > 2.5 mg/dl or creatinine clearance <30mL/min within 90 days prior to enrollment
- Any other significant uncontrolled or unstable medical condition (e.g. sepsis, acute metabolic illness)
- Enrolled in any concurrent study without Boston Scientific written approval
- Women who are pregnant or plan to become pregnant within the course of their participation in the investigation
- Life expectancy ≤2 years (730 days) per physician opinion

2. Follow-up Schedule

All patients were scheduled to return for follow-up examinations at 10 ± 3 days and 90 ± 14 days postoperatively. Adverse events and complications were recorded at all visits.

Table 9 lists the protocol-required baseline, procedural, and follow-up assessments.

Table 9: Data Collection and Testing Summary

Reportable Data Items	Enrollment	Pre-Ablation	Ablation Procedure	Pre-Discharge	10-Day	3-Month	Un-scheduled Follow-up[@]
Visit Window	N/A	≤60 days post-enrollment	≤60 days post-enrollment	4-72 hrs. post-procedure	10 ± 3 days post-procedure	90 ± 14 days post-procedure	N/A
12-lead ECG	--	--	√	√	√	√	√
Demographics	√	--	--	--	--	--	--
Medications	√	--	√	√	√	√	√
Trans-thoracic Echo	--	√	--	√	--	--	--
Trans-esophageal Echo	--	√[#]	--	--	--	--	--
Physical Assessment	√	--	--	√	--	√	√
Symptom Checklist	√	--	--	--	--	√	--
Symptom Assessment	--	--	--	√	√	--	√
Procedural Data	--	√	√	--	--	--	--
Trans-telephonic Monitor	--	--	--	√[*]	√[*]	--	√[*]
Adverse Events	--	√	√	√	√	√	√

√ Required
-- Not required
* Only required if arrhythmia is not confirmed at visit
# Only required prior to the procedure for subjects in persistent AFL or those that are in AFL on the day of the procedure, unless they have been adequately anticoagulated on warfarin with an INR >2.0 for at least 21 days or continuously anticoagulated on dabigatran or other anticoagulants FDA approved for use in subjects with type 1 AFL for 21 days
@ Only required if subject reports symptoms associated with cardiac arrhythmias after the ablation procedure or if the subject has already received a trans-telephonic monitor (TTM) and a suspected AFL recurrence has been recorded.

3. Study Endpoints

Primary Safety Endpoint

The Primary Safety Endpoint was the procedure-related complication- free rate at 7 days post-procedure. Procedure-related complications were defined as adverse events that are related to the ablation procedure or catheter and result in death, life threatening complication, or a persistent or significant disability/incapacity or required intervention to prevent impairment of a body function or damage to a body structure. The difference in procedure-related complication free rates between the randomized groups was calculated and compared against a 10% non-inferiority margin.

Primary Effectiveness Endpoint

The Primary Effectiveness Endpoint was Acute Success. Acute Success was defined as demonstration of bi-directional cavo-tricuspid isthmus (CTI) block 30 minutes following the last RF application in the CTI with the sole use of the randomized Investigational or selected Control Catheter only. Acute Success was evaluated for each randomized group and the difference between the two groups was compared against a 10% non-inferiority margin.

Secondary Effectiveness Endpoints

The secondary effectiveness endpoint for the study was Chronic Success, evaluated separately for All Treated subjects (all subjects that had an ablation procedure) and Acute Success subjects. Chronic Success was defined as freedom from recurrence of type I atrial flutter at 3 months post procedure. Subjects who were prescribed anti-arrhythmic drugs (AADs) for the treatment of type I AFL during the follow-up period were considered chronic failures. Chronic Success was evaluated in two secondary endpoints: Chronic Success in Acute Successes and Chronic Success in All Treated Subjects. The difference in chronic success rates between the randomized groups was compared against a 10% non-inferiority margin.

Tertiary Objectives

The following was evaluated for differences between the Investigational and Control groups as tertiary objectives:

- Total procedure time (first catheter inserted to last catheter removed)
    - Procedure time for patients without concomitant arrhythmias ablated
    - Procedure time for patients with concomitant arrhythmias ablated*
- Fluoroscopy time
    - Fluoroscopy time for patients without concomitant arrhythmias ablated
    - Fluoroscopy time for patients with concomitant arrhythmias ablated

- Total number of RF applications per patient
- Cumulative RF time per patient
- Frequency and severity of arrhythmia-related symptoms at 3 months post-procedure as compared to baseline

C. Accountability of PMA Cohort

At the time of database lock, of 302 patients enrolled in the PMA study, 72.8% (220) patients were eligible for analysis at the completion of the study, the 3-month post-operative visit.

All subjects who signed the Informed Consent form were considered enrolled in the study and counted towards the enrollment ceiling. Subjects were classified as either part of the Roll-in cohort or the Randomized cohort.

Roll-in – To facilitate the investigator's familiarity with the Blazer Open-Irrigated Ablation Catheter and the EGMs, the study included a cohort of subjects considered to be "Roll-in" subjects. Investigational sites without previous experience with the Blazer Open-Irrigated Ablation Catheter or the Control Catheter were required to utilize one Roll-in subject for each treatment arm. Roll-in requirements could be waived for investigational sites that had previous experience.

Randomized – Once the roll-in requirements were met at an investigational site, the subsequent enrolled subjects were part of the randomized cohort, and were randomized 1:1 to receive treatment with either the Control Catheter or the Investigational Catheter.

Enrolled subjects were further classified into the subject statuses described below.

Intent – A subject who had been enrolled but then withdrawn from the study and did not undergo the protocol-required ablation procedure.

Attempt – A subject who had been enrolled and had anesthesia or sedation administered in preparation for the ablation procedure but did not receive ablation therapy with the treatment or Control Catheter per protocol.

Treatment subject – A subject who had an ablation procedure and received ablation therapy with the Investigational or Control Catheter.

Each primary endpoint was analyzed based on Modified Intention-to-Treat (mITT), Per-Protocol, and As Treated populations with the mITT population being the primary population. The mITT population included all Randomized Treatment subjects in their randomized group, regardless of compliance to the assigned treatment. The Per-Protocol analysis included subjects who were treated with the randomized catheter, had complete endpoint data, and had no major protocol violations. And the As Treated analysis was done for each primary endpoint to account for one subject where the subject was randomized to the Investigational

catheter but mistakenly treated with the Control catheter. The As Treated analysis included subjects in the group for which they received treatment, regardless of randomization.

Table 10 shows the disposition of subjects in the BLOCk-CTI study. There were five subjects enrolled and classified as part of the Randomized cohort, but who withdrew prior to being randomized. Subjects that were randomized and underwent an ablation procedure were referred to as Randomized Treatment subjects, and these were the subjects eligible for endpoint analyses. Among the Randomized Cohort, there were 30 Randomized subjects classified as Intents (20 subjects) or Attempts (10 subjects). Since these subjects did not have an ablation procedure, they were not eligible for any endpoint analyses.

Subjects classified as Roll-ins, Not Randomized, Randomized Intents and Randomized Attempts were not included in endpoint analyses. Error! Reference source not found. **Table 10** also summarizes the accountability of the Randomized Treatment subjects for inclusion in each endpoint analysis for each analysis type.

Table 10: Subject Disposition and Accountability for Endpoint Analysis

	Control	**Investigational**	**Total**
Enrolled subjects			**302**
Roll-In Cohort	**17**	**30**	**47**
Not Randomized	**N/A**	**N/A**	**5**
Randomized Cohort	**125**	**125**	**250**
Intents	**10**	**10**	**20**
Subject did not meet eligibility criteria	4	4	8
Subject refused testing/follow-up	1	1	2
Subject withdrawn by physician	2	3	5
Insurance issues	2	1	3
Lab equipment issues	1	1	2
Attempts	**4**	**6**	**10**
Subject did not meet eligibility criteria	3	3	6
Lab equipment issues	1	2	3
Subject anatomical issues	0	1	1
Treatment subjects (eligible for endpoint analysis)	**111**	**109**	**220**
3-Month Follow-Up Visit Completed	106	104	210
3-Month Follow-Up Visit Not Completed	5	5	10
Death	0	1	1
Withdrawals	1	3	4
Additional missed 3-month follow-ups	4	1	5

	Control	Investigational	Total
Endpoint Accountability for Randomized Treatment Subjects (n=220)			
Primary Safety: 7 Day Procedure-related Complications			
Modified Intention-to-treat	**111**	**109**	**220**
Per Protocol	**111**	**107**	**218**
Excluded due to randomization error *	0	1	1
Excluded due to withdrawal within 7 days	0	1	1
As Treated*	**112**	**108**	**220**
Primary Effectiveness: Acute Success			
Modified Intention-to-treat	**111**	**109**	**220**
Per Protocol	**111**	**108**	**219**
Excluded due to randomization error *	0	1	1
As Treated*	**112**	**108**	**220**
Secondary Effectiveness: Chronic Success in All Treated Subjects			
Modified Intention-to-treat	**111**	**109**	**220**
Secondary Effectiveness: Chronic Success in Acute Success Subjects			
Modified Intention-to-treat (Acute Success subjects only)	**99**	**95**	**194**

* One subject randomized to Investigational group was treated with the Control Catheter only.

There were four Randomized Treatment subjects that withdrew from the study. A summary of withdrawal reasons for these subjects is included in **Table** .

Table 11: Randomized Treatment Subjects Withdrawal Summary

Reason	Control	Investigational
Subject refused testing/follow-up	0	2
Subject "lost to follow-up"	1	1
Total	**1**	**3**

D. Study Population Demographics and Baseline Parameters

The average age of the subjects was 66 ± 10 years for the Control Group and 65 ± 11 years for the Investigational Group. For both treatment groups, the majority of subjects were male. The Control Group enrolled 96 male subjects (76.8%) and the Investigational Group enrolled 102 male subjects (81.6%). There were 29 females enrolled in the Control Group, (23.2%) and 23 female subjects enrolled in the Investigational Group, (18.4%). The demographics of the study population are typical for an atrial flutter ablation study performed in the US.

Overall, there were no significant imbalances in baseline characteristics between the two treatment groups as shown in **Table 11**.

Table 11: Baseline Characteristics
(Randomized Cohort N=250)

Characteristic	Measurement or Category	Control (N=125)	Investigational (N=125)	P-value
Age (years)	N	125	125	0.66
	Mean ± SD	66 ± 10	65 ± 11	
	Range	35 - 85	25 - 91	
Gender [N (%)]	Female	29 (23.2)	23 (18.4)	0.35
	Male	96 (76.8)	102 (81.6)	
Cardiac and cardiovascular disease history	Hypertrophic Cardiomyopathy [N (%)]	1 (0.8)	2 (1.6)	0.56
	Ischemic Cardiomyopathy [N (%)]	12 (9.6)	9 (7.2)	0.49
	Non-ischemic Cardiomyopathy [N (%)]	2 (1.6)	3 (2.4)	0.65
	Congestive Heart Failure (CHF) [N (%)]	22 (17.6)	17 (13.6)	0.38
	Coronary Artery Disease [N (%)]	44 (35.2)	44 (35.2)	1.00
	Hypertension [N (%)]	88 (70.4)	81 (64.8)	0.34
	Prior Myocardial Infarction [N (%)]	20 (16.0)	23 (18.4)	0.62
	Valvular Disease [N (%)]	22 (17.6)	27 (21.6)	0.43
Cardiac intervention/surgery history	Angiography/Angio plasty [N (%)]	13 (10.4)	12 (9.6)	0.83
	Stent [N (%)]	20 (16.0)	10 (8.0)	0.05
	CABG [N (%)]	25 (20.0)	24 (19.2)	0.87
	Device Implant (CRT) [N (%)]	1 (0.8)	0 (0)	0.32
	Device Implant (ICD) [N (%)]	8 (6.4)	5 (4.0)	0.39
	Pacemaker Implant [N (%)]	3 (2.4)	10 (8.0)	0.05

Characteristic	Measurement or Category	Control (N=125)	Investigational (N=125)	P-value
	Heart valve repair/replacement [N (%)]	5 (4.0)	12 (9.6)	0.08
Significant non-cardiovascular disease history	Type II Diabetes [N (%)]	35 (28.0)	30 (24.0)	0.47
	Hyperlipidemia [N (%)]	75 (60.0)	77 (61.6)	0.80
Conduction disorder	1st Degree AV Block [N (%)]	13 (10.4)	17 (13.6)	0.44
	2nd Degree AV Block (Mobitz I) [N (%)]	2 (1.6)	9 (7.2)	0.03
	2nd Degree AV Block (Mobitz II) [N (%)]	2 (1.6)	0 (0)	0.16
History of Non-Type 1 AFL atrial arrhythmias	Atrial Fibrillation [N (%)]	57 (45.6)	72 (57.6)	0.08
	Atypical Atrial Flutter [N (%)]	2 (1.6)	2 (1.6)	1.00
	Sick Sinus Syndrome [N (%)]	9 (7.2)	7 (5.6)	0.61

E. Procedural Data

The goal of the ablation procedure was to produce bi-directional conduction block between the tricuspid annulus and inferior vena cava at the CTI. Subjects with type 1 atrial flutter were randomized to be treated with either the Investigational device or the Control device in the ablation procedure. Three subjects were ablated for a concomitant arrhythmia, two subjects for atrial tachycardia and one subject for atrial fibrillation and atypical flutter, during the index procedure for type 1 atrial flutter.

Control Catheters Used

Investigators used a total of 112 Control Catheters as the initial catheter in the ablation procedure for 111 Randomized Control subjects and one (1) randomized to the Investigation group. The ThermoCool Open-Irrigated catheter (Biosense Webster) was the most frequently used catheter in the Control group (66/112), followed by the ThermoCool OI Nav catheters (32/112) and the St. Jude Medical Cool Path, Therapy Cool Path, and Safire BLU Duo Ablation catheters (14/112).

Ablation Parameters

The ablation parameters to achieve bidirectional block are shown in Error! Not a valid bookmark self-reference. for the Control and Investigational Catheters.

Table 12: Ablation Parameters*

Procedure Parameter	Measurement	Control N=111	Investigational N=109
RF Applications with randomized catheter	N	1262	1313
	Mean ± SD	14 ± 12	15 ± 10
	Range	1-71	1-67
Ablation Duration (seconds)	N	1260	1313
	Mean ± SD	96 ± 91	91 ± 78
	Range	0 - 999	0 - 742
Starting Power	N	1260	1306
	Mean ± SD	20 ± 2	19 ± 2
	Range	0 - 35	0 - 30
Max Power (W)	N	1259	1308
	Mean ± SD	36 ± 7	37 ± 9
	Range	0 - 50	0 - 50
Average Power (W)	N	1255	1301
	Mean ± SD	31 ± 7	32 ± 8
	Range	0 - 48	0 - 49
Max Temperature (°C)	N	1259	1300
	Mean ± SD	38 ± 5	33 ± 3
	Range	23 - 63	0 - 72
Average Temperature (°C)	N	1255	1301
	Mean ± SD	34 ± 4	29 ± 2
	Range	23 - 51	21 - 46
Max Impedance (Ω)	N	1254	1299
	Mean ± SD	141 ± 51	155 ± 46
	Range	62 - 999	0 - 940
Average Impedance (Ω)	N	1255	1300
	Mean ± SD	119 ± 30	132 ± 34
	Range	35 - 380	33 - 230

* Only includes data from randomized catheters.

Fluids Received During the Procedure

Procedural fluids administered via the open-irrigated catheters and non-catheter sources were recorded as shown in **Table 13**. The investigational catheter used more

fluid than the Control Catheter. Patients randomized to the Control Group received an ablation using any open irrigated RF ablation catheter with FDA market approval for the treatment of type 1 AFL, when used in conjunction with the catheter's corresponding market-approved generator and pump. Fluid infusion rates for the Control Catheter pump(s) were programmed per the manufacturer's instructions for use and some had lower flow rates than the Investigational Catheter. The choice of the Control Catheter used during the procedure was left up to the discretion of the Investigator.

Table 13: Fluid and Flow Rates Recorded During the Ablation Procedure

Fluid infusion	Measurement	Control	Investigational
Primary flow rate for RF applications <= 30W	N	110	109
	Mean ± SD	18 ± 7	20 ± 6
	Range	8 - 30	15 - 30
Primary flow rate for RF applications > 30W	N	110	107
	Mean ± SD	25 ± 7	30 ± 1
	Range	13 - 30	15 - 30
Total fluid infused through ablation catheter (mL)	N	108	108
	Mean ± SD	611 ± 433	699 ± 386
	Range	20 - 2346	50 - 1881
Total fluid infused through non-catheter sources (mL)	N	109	109
	Mean ± SD	449 ± 337	544 ± 416
	Range	0 - 1900	0 - 2000
Total fluid output from the patient (mL)	N	110	109
	Mean ± SD	113 ± 304	133 ± 393
	Range	0 - 1300	0 - 2200

F. Safety and Effectiveness Results

Primary Safety Endpoint

The objective of the Primary Safety Endpoint was to demonstrate that the proportion of subjects free from procedure-related complications in the Investigational group is non-inferior to that in the Control group. The Primary Safety Endpoint analysis includes all Randomized Treatment subjects (111 Control and 109 Investigational). Based on the Modified Intention-to-Treat (mITT) analysis, the 7 day Procedure-related Complication-free rate was 98.2% in the Control group and 93.6% in the Investigational group. The difference in the 7-day Procedure-related Complication-free Rate between the Control and the Investigational groups was 4.6%. The upper 95% confidence bound of 9.78% was less than the non-inferiority margin of 10%, demonstrating non-inferiority between the two groups.

The results of the Primary Safety Endpoint are shown in **Table** . The Primary Safety Endpoint results were consistent across three analysis cohorts (i.e. mITT, PP and AT)

and supported the safety of the Blazer Open-Irrigated Ablation Catheter for the treatment of type 1 atrial flutter.

Table 15: Primary Safety Endpoint Results
(Randomized Treatment Subjects N=220)

Analysis Cohort	Study Group	Subjects Event-Free	Treatment Subjects	Procedure-Related Complication-Free Rate	Difference (One-Sided Upper 95% Bound)	Endpoint Result
mITT	Control	109	111	98.2%	4.6% (9.78%)	Pass
	Investigational	102	109	93.6%		
PP	Control	109	111	98.2%	4.7% (9.98%)	Pass
	Investigational	100	107	93.5%		
AT	Control	110	112	98.2%	4.7% (9.89%)	Pass
	Investigational	101	108	93.5%		

Of the 220 Randomized Treatment subjects, 9 subjects (7 investigational and 2 Control) had procedure-related complications that are detailed in **Table 14**.

Table 14: Primary Safety Endpoint Events by Group
(Randomized Treatment Subjects N=220)

Primary Safety Events	Investigational Group N = 109	Control Group n = 111
Cardiovascular Accident (CVA) Resulting in Death	1 (0.9%)	0
Congestive Heart Failure	0	1 (0.9%)
Hypotension	2 (1.8%)	0
Vasovagal Reaction	1 (0.9%)	0
Junctional Rhythm Requiring Pacemaker Implantation	1 (0.9%)	0
Pseudoaneurysm with Hematoma	0	1 (0.9%)
Pseudoaneurysm	1 (0.9%)	0
Urinary Tract Infection	1 (0.9%)	0
Total	**7* (6.4%)**	**2 (1.8%)**

* None of the Primary Safety events in the Investigational group was adjudicated by the Clinical Events Committee as related to the Blazer Open-Irrigated Ablation Catheter.

There were no device-related complications reported in the Randomized Treatment subjects.

There was one death reported during the course of the clinical study that was adjudicated by the Clinical Events Committee as procedure-related event. The subject

was a 64 year old male with a medical history of coronary artery disease (CAD), hypertension, and myocardial infarction (MI) with coronary artery bypass graft surgery. The subject also had a history of chronic obstructive pulmonary disease (COPD), hyperlipidemia and asthma. There was no prior history of embolic phenomena and the subject was Class 1 for the New York Heart Association Functional Classification. The subject was on ASA (325mg.QD) for 21 days pre-procedure and Accupril for persistent type 1 atrial flutter. No anticoagulation therapy was administered prior to, during or after the ablation procedure. No transesophageal echocardiogram (TEE) was performed to exclude left atrial thrombus prior to the ablation procedure. The subject underwent CTI ablation using the Investigational Catheter and acute success was achieved without immediate complications. On day three post procedure, the subject presented to the Emergency Department with left sided weakness, facial droop, aphasia and dysarthria. Head CT was negative for acute intracranial hemorrhage. The diagnosis of ischemic stroke (right MCA distribution) was made. Shortly after thrombolysis therapy with IV tPA administrated within two hours of symptom onset, the subject deteriorated. Repeat head CT showed massive parenchymal hemorrhagic transformation of the infarct with massive effect and midline shift. The subject passed away on day four post procedure. The cause of the death was massive cerebral hemorrhage status post tPA for embolic stroke. The ischemic stroke could be attributed to inadequate peri-procedure anticoagulation and lack of pre-procedure TEE for exclusion of left atrial thrombus. Not performing a TEE prior to the ablation procedure in this subject with persistent AFL who was not anticoagulated pre-procedure was also a study protocol violation.

Primary Effectiveness Endpoint-Acute Success

Acute Success was defined as demonstration of bi-directional CTI block 30 minutes following the last RF application in the CTI, with the sole use of the randomized Investigational or selected Control catheter. If multiple catheter curves of a single catheter type or a change of a unidirectional to bidirectional model were required, it did not affect the outcome determination of Acute Success. However, if the Control or Investigational open-irrigated catheter was switched for another manufacturer's catheter, open-irrigated or standard, or switched from non-navigation to a navigation model, it did affect the Primary Effectiveness Endpoint, Acute Success, as these switches were counted as Failures.

The objective of the Primary Effectiveness Endpoint was to demonstrate that the proportion of subjects with Acute Success in the Investigational group was non-inferior to that in the Control group.

The Modified Intention-to-Treat analysis of the Primary Effectiveness Endpoint included all 220 Randomized Treatment subjects (111 Control and 109 Investigational). Based on the Modified Intention-to-Treat analysis, the Acute Success rate was 89.2% in the Control group and 87.2% in the Investigational group, respectively. The difference in the Acute Success rates between the Control Group and the Investigational Group was 2.03%. The upper 95% confidence bound of

9.37% was less than the non-inferiority margin of 10%, demonstrating non-inferiority between the two groups.

The results of the Primary Effectiveness Endpoint are shown in **Table 15**. The results of the Per-Protocol and As Treated analyses were consistent with the mITT analysis and supported the effectiveness of the Blazer Open-Irrigated Ablation Catheter for the treatment of type 1 atrial flutter.

Table 15: Primary Effectiveness Endpoint Results: Acute Success
(Randomized Treatment Subjects N=220)

Analysis Cohort	Study Group	Successful Procedures	Total Procedures	% Success	Difference (One-Sided Upper 95% Bound)	Endpoint Result
mITT	Control	99	111	89.2%	2.03% (9.37%)	Pass
	Investigational	95	109	87.2%		
PP	Control	99	111	89.2%	2.15% (9.53%)	Pass
	Investigational	94	108	87.0%		
AT	Control	100	112	89.3%	2.25% (9.61%)	Pass
	Investigational	94	108	87.0%		

Secondary Effectiveness-Chronic Success

Chronic Success was defined as freedom from recurrence of type I atrial flutter at 3 months post procedure. Chronic Success was evaluated for the All Treated subjects and the Acute Success subjects separately. The objective of each of the Secondary Effectiveness Endpoints was to demonstrate that the proportion of subjects with Chronic Success in the Investigational group was non-inferior to that in the Control group.

Subjects that were followed through 3 months or had an ECG documented recurrence of type I atrial flutter with less than 3 months of follow-up were considered to have complete data. Subjects that withdrew or died with no arrhythmia recurrence or did not follow the protocol with regards to follow-up requirements were considered to have incomplete data. These subjects with incomplete data were reviewed to determine if there was sufficient data to determine Chronic Success. Subjects with insufficient data to determine Chronic Success were included in the analysis, but could not be considered as Chronic Successes, and therefore counted against the endpoint.

Among the 220 Randomized Treatment subjects, 19 (10 control and 9 investigational) had incomplete data due to death (n = 1, one investigational), request to be withdrawn (n = 4, one control and three investigational), or missing follow-up ECG/visit (n = 14, 9 control and 5 investigational).

Six subjects in the Investigational group (5 acute successes and one acute failure) had ECG documented type I AFL recurrence during the 3 month follow-up period and

thus were classified as chronic failures; no subjects from the Control group were classified chronic failures due to ECG documented type I AFL recurrence or on AADs for type I AFL during follow-up.

Chronic Success in Acute Successes

The analysis of this secondary endpoint was performed in the Modified Intention-to-Treat cohort and included only Randomized Treatment subjects who had Acute Success (99 Control and 95 Investigational). The Chronic Success rate was 89.9% in the Control group and 85.3% in the Investigational group, respectively. The difference in the Chronic Success rates between the Control and the Investigational groups was 4.64%. The upper 95% confidence bound of 12.64% was greater than the non-inferiority margin of 10%, resulting in failure to demonstrate non-inferiority between the two groups. The results of this secondary endpoint analysis are shown in Error! Reference source not found..

Table 16: Chronic Success in Acute Successes
(Randomized Treatment Subjects with Acute Success N=194)

Analysis Cohort	Study Group	Chronic Success	Total Acute Subjects	% Success	Difference (One-Sided Upper 95% Bound)	Endpoint Result
mITT	Control	89	99	89.9%	4.64% (12.64%)	Fail
	Investigational	81	95	85.3%		

Chronic Success in All Treated Subjects

The analysis of this secondary endpoint was performed in the Modified Intention-to-Treat cohort and included all 220 Randomized Treatment subjects (111 Control and 109 Investigational). In this analysis, all acute failures were classified as chronic failures.

The Chronic Success rate was 80.2% in the Control Group and 74.3% in the Investigational group, respectively. The difference in the Chronic Success rates between the Control and the Investigational groups was 5.87%. The upper 95% confidence bound of 15.08% was greater than the non-inferiority margin of 10%, resulting in failure to demonstrate non-inferiority between the two groups. The results of this secondary endpoint are shown in **Table 17**.

Table 17: Chronic Success in All Treated Subjects
(Randomized Treatment Subjects N=220)

Analysis Cohort	Study Group	Chronic Success	Total Treatment Subjects	% Success	Difference (One-Sided Upper 95% Bound)	Endpoint Result
mITT	Control	89	111	80.2%	5.87% (15.08%)	Fail
	Investigational	81	109	74.3%		

The clinical study failed to statistically demonstrate non-inferiority in chronic success. However, it should be noted that the study was not powered to test the non-inferiority hypothesis for chronic success. The observed difference in chronic success between the two study groups (about 5%) is not considered clinically meaningful. The vast majority of the acute successes in the Investigational group with complete follow-up data had no type I atrial flutter recurrence during follow-up, supporting the effectiveness of the Blazer Open-Irrigated Ablation Catheter for the treatment of type 1 atrial flutter.

Data Summary on Tertiary Objectives

The tertiary objectives included procedure time, fluoroscopy time, number of RF applications, RF time, and changes in frequency and severity of arrhythmia-related symptoms. These data are summarized in **Table** .

Table 20: Tertiary Objectives Summary
(Randomized Treatment Subjects N=220)

Tertiary Objective	Measurement	Control (N=111)	Investigational (N=109)
Total procedure time for subjects without concomitant arrhythmias ablated (minutes)	N	108	109
	Mean ± SD	94 ± 41	98 ± 34
	Minimum - Maximum	44-250	33-190
	Median	83	93
Total procedure time for subjects with concomitant arrhythmias ablated (minutes)	N	3	0
	Mean ± SD	153 ± 86	NA
	Minimum - Maximum	84-249	NA
	Median	127	NA
Fluoroscopy time for subjects without concomitant arrhythmias ablated (minutes)	N	108	109
	Mean ± SD	14 ± 15	17 ± 10
	Minimum - Maximum	0-83	2-46
	Median	10	15
Fluoroscopy time for subjects with concomitant arrhythmias ablated (minutes)	N	3	0
	Mean ± SD	53 ± 65	NA
	Minimum - Maximum	11-127	NA
	Median	20	NA
Total number of RF applications per patient	N	111	108
	RF applications per patient	12.4	13.6
Cumulative RF time per patient (seconds)	N	110	108
	Mean ± SD	1170 ± 976	1199 ± 842
	Minimum - Maximum	180-4739	159-4452
	Median	856	992

Tertiary Objective	Measurement	Control (N=111)	Investigational (N=109)
Change in frequency of arrhythmia-related symptoms (3 months-baseline)	N	106	104
	Mean ± SD	-6.9 ± 7.4	-7.8 ± 7.4
	Minimum, Maximum	-25, 15	-35, 11
	Median	-5	-6
Change in severity of arrhythmia-related symptoms (3 months-baseline)	N	106	104
	Mean ± SD	-5.3 ± 6.8	-5.9 ± 6.2
	Minimum, Maximum	-28, 11	-26, 7
	Median	-4	-4.5

G. Financial Disclosure

The Financial Disclosure by Clinical Investigators regulation (21 CFR 54) requires applicants who submit a marketing application to include certain information concerning the compensation to, and financial interests and arrangement of, any clinical investigator conducting clinical studies covered by the regulation. The pivotal clinical study included 85 investigators of which 0 were full-time or part-time employees of the sponsor and 2 had disclosable financial interests/arrangements as defined in 21 CFR 54.2(a), (b), (c) and (f) and described below:

- Compensation to the investigator for conducting the study where the value could be influenced by the outcome of the study: 0
- Significant payment of other sorts: 2
- Proprietary interest in the product tested held by the investigator: 0
- Significant equity interest held by investigator in sponsor of covered study: 0

The applicant has adequately disclosed the financial interest/arrangements with clinical investigators. Statistical analyses were conducted by FDA to determine whether the financial interests/arrangements had any impact on the clinical study outcome. The information provided does not raise any questions about the reliability of the data.

XI. PANEL MEETING RECOMMENDATION AND FDA'S POST-PANEL ACTION

In accordance with the provisions of section 515(c)(3) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Circulatory System Devices Advisory Panel, an FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XII. CONCLUSIONS DRAWN FROM PRECLINICAL AND CLINICAL STUDIES

A. Effectiveness Conclusions

The BLOCk-CTI clinical study met its primary effectiveness endpoint by demonstrating non-inferiority of the Blazer Open-Irrigated Ablation Catheter to the Control Catheters in acute success (defined as the achievement of bidirectional cavo-tricuspid isthmus block), an accepted surrogate effectiveness endpoint for RF catheter ablation of type I atrial flutter (AFL). The clinical study failed to statistically demonstrate non-inferiority in chronic success (defined as freedom from type I AFL recurrence during 3 month follow-up), which was the secondary effectiveness endpoint. It should be noted that the study was not powered to test the non-inferiority hypothesis for chronic success. Consistent with the results of other AFL ablation studies for similar technologies, approximately 95% of the subjects in the investigational group who had acute success and complete follow-up data were free of type I AFL recurrence during 3 month follow-up, the study's definition for chronic success. Moreover, the observed difference in chronic success between the two study groups (about 5%) is not considered clinically meaningful. Taken together, these data provide a reasonable assurance that the Blazer Open-Irrigated Ablation Catheter is effective for the treatment of type I AFL.

B. Safety Conclusions

The risks of the device are based on nonclinical laboratory and animal studies as well as data collected in a clinical study conducted to support PMA approval as described above. The BLOCk-CTI clinical study met its primary safety endpoint and demonstrated non-inferiority of the Blazer Open-Irrigated Ablation Catheter to the Control Catheters in terms of 7-day procedure-related complication rate. There were no device related complications in the Investigational group. The data supports the safety of the Blazer Open-Irrigated Ablation Catheter for the treatment of type I AFL.

C. Benefit-Risk Conclusions

The preclinical and clinical data presented support the notion that the probable benefits outweigh the probable risks when the Blazer Open-Irrigated Ablation Catheter is used for the treatment of type I AFL.

D. Overall Conclusions

The preclinical and clinical data in this application support the reasonable assurance of safety and effectiveness of the Blazer Open-Irrigated Ablation Catheter when used in accordance with the Indications for Use.

XIII. CDRH DECISION

The clinical study was performed using the Blazer Open-Irrigated Ablation Catheter with the Stockert 70 RF generator and Coolflow Irrigation Pump. However, on the basis of the engineering testing and the Thigh Prep study described in Section IX, the results of the BLOCk-CTI study may be extrapolated to the use of Blazer Open-Irrigated Ablation Catheter with the Maestro 4000 Generator and MetriQ Pump. Boston Scientific Corporation has elected to seek PMA approval for only the Maestro 4000 RF generator and MetriQ Pump and the Stockert 70 RF generator and Coolflow Pump are not PMA approved components of the Blazer Open-Irrigated Ablation Catheter system.

CDRH issued an approval order on February 24, 2016

The applicant's manufacturing facilities have been inspected and found to be in compliance with the device Quality System (QS) regulation (21 CFR 820).

XIV. APPROVAL SPECIFICATIONS

Directions for use: See device labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions, and Adverse Events in the device labeling.

Post-approval Requirements and Restrictions: See approval order.

XV. REFERENCES

1. IEC 60601-1, *Medical electrical equipment – Part 1: General requirements for basic safety and high frequency accessories*
   IEC 60601-2-2, *Medical electrical equipment – Part 2-2: Particular requirements for safety and essential performance of high frequency surgical equipment and high frequency accessories*
   IEC 60601-1-2, *Medical electrical equipment Part 1-2: General requirements for safety and essential performance – Collateral standard: Electrical compatibility – requirements and tests*

2. Nakagawa et al. Circulation 1995, 91: 2264-2273 and Circulation 1998, 98: 458-465.