RISKS
WBS 1.0 ANU PLANNING ENGINEERING & DESIGN

Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
Work can not be accomplished as planned	1.0 - ANU Planning, Engineering &Design	Threat	Grossman, Nancy	95	Lack of needed AD & FNAL resources to accomplish the work	Work to get TD/PPD manpower to help and contract help – takes longer as those people need to be trained/overseen and thus costs more.	Work can not be accomplished as planned	See NOvA Risk Form in NOvA-Doc-1446.	0.38	Top Priority
Insufficient manpower resources	1.0.3 - NuMI Upgrades	Threat	Grossman, Nancy	26	Operational demands on AD manpower and/or other higher priority projects	Takes longer to do work	Insufficient manpower resources	See NOvA Risk Form in NOvA-Doc-1446.	0.35	Top Priority
electrocution	1.0.1.2.1.3.7 - High Voltage Testing of 1st Prototype RR Inj/Gap Clearing Magnet in TG Cage	Threat	Grossman, Nancy	50	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted is restricted access areas under careful supervision with standard FNAL LOTO procedures.	0.11	Middle Priority
electrocution	1.0.1.2.2.3.5 - RR Injection & Gap Clearing HV & Impedance Testing of Cable	Threat	Grossman, Nancy	55	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures.	0.11	Middle Priority
magnets don't meet specs	1.0.1.2.1.1.9 - Revise RR Inject & Gap Clearing Magnet Design for Production& Choose Ferrite (After 4th/Final Test)	Threat	Grossman, Nancy	17	ferrite design doesn't work(fields aren't as expected)	either accept with reduced magnet characteristics (not meet rise and/or falltimes) or try again with another ferrite design (depending on how close we are to meeting specs)	magnets don't meet specs	Three different ferrite designs and four tests are planned, to reduce the probability of having no successful design. Also there is relatively large contingency for these tasks. Task on or near critical path for ANU.	0.20	Middle Priority
not enough resistors meet spec	1.0.1.2.1.2.10 - Procure Prototype Load& Adaptor	Threat	Grossman, Nancy	19	hard for vendor to meet specs based on experience	buy more resistors	not enough resistors meet spec	Buying many more than we need in order to have enough that meet spec. Contingency to buy more. Also some float in task to cover some schedule loss..	0.15	Middle Priority
load resistors out of spec	1.0.1.2.1.3.5 - Assemble Prototype Load& Adaptor	Threat	Grossman, Nancy	44	resistor production method not conducive to making parallel sides, resistance values are a random distribution	order more resistors	load resistors out of spec	Vendor pre-qualified, ordering 10% extra to allow for rejects.	0.17	Middle Priority
magnet won't meet specs	1.0.1.2.1.3.6 - Low voltage testing of 1stPrototype Magnet	Threat	Grossman, Nancy	45	design not quite right	reject his design and use/test one of the other designs or update/correct design	magnet won't meet specs	Contingency in task. Some float in task. Magnets to test 3 different ferrite designs at low voltage, filled with fluorinert so they can be easily revised if necessary, to reduce the probability of having no successful design.	0.20	Middle Priority
Ceramic tubes out of tolerance in straightness spec	1.0.1.2.1.2.3 - RR Injection Kicker Magnet Measure Tubes as Received	Threat	Grossman, Nancy	41	Vendor didn't meet dimensional specs	Re-evaluate kicker design and specs	Ceramic tubes out of tolerance in straightness spe	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
capacitors or ferrites out of spec	1.0.1.2.4.2.2.2 - Receive Capacitors &Ferrites for 1 Test Magnet	Threat	Grossman, Nancy	56	vendor didn't meet capacitance or dimensional specs or ferrites damaged	order more capacitors or ferrites	capacitors or ferrites out of spec	Ordering extra to allow for rejects, ordering early to allow time for inspection and reordering if necessary. Schedule has float and contingency.	0.17	Middle Priority
Measurements not completed	1.0.4.2.6 - Electron Cloud Measurement in MI & RR	Threat	Grossman, Nancy	84	Difficulty of installation in RR	Lack instrumentation to directly measure electron cloud activity	Measurements not completed	Integrate installation into other RR jobs. Some contingency and float in this task to mitigate.	0.23	Middle Priority
Analysis not completed	1.0.4.2.9 - Beam Cleaning Analysis	Threat	Grossman, Nancy	87	Unanticipated changes and complexity	Poor prediction of gains from beam cleaning system	Analysis not completed	Develop analyses of different levels of complexity. Some contingency and float in this task to mititate.	0.12	Middle Priority

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WBS 1.0 ANU PLANNING ENGINEERING & DESIGN

Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
poor beam quality and/or losses	1.0.4.1.1 - Evaluate Booster Performance for ANU	Threat	Grossman, Nancy	20	poor beam quality and/orlosses	limits beam injected to RR	poor beam quality and/or losses	Very hard to define as depends on how bad the beam quality/losses are in order to decide the severity of the impact. The reason we are closely watching the Proton Plan is to mitigate this early is necessary. Loss requirements are nearly met at this point in time and beam quality is marginal, but close to what is needed for ANU.	0.24	Middle Priority
electrocution	1.0.1.2.1.3.9 - Low Voltage & HighVoltage Testing of 3rd Prototype Magnet	Threat	Grossman, Nancy	52	person touching HV current source or exposed conductor	personal injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures.	0.11	Middle Priority
magnet won't meet specs	1.0.1.2.1.3.10 - Assemble 2nd Prototype Magnet	Threat	Grossman, Nancy	53	design not quite right	reject his design and use/test one of the other designs or update/correct design	magnet won't meet specs	Building 3 different magnets to test 3 different ferrite designs at low voltage, filled with fluorinert so they can be easily easily revised if necessary, to reduce the probability of having no successful design. Contingency in task to cover some cost overruns.	0.20	Middle Priority
decision to redesign ferrites	1.0.1.2.7.6 - RR Ferrite Procurement Finalized	Threat	Grossman, Nancy	57	magnet won't meet specs after 4 tests and specs can't be changed to meet test results	delay in production of kicker magnets	decision to redesign ferrites	Tests to be conducted as soon as possible to minimize probability of delays. Some tasks in this path have float, allh ave contingency.	0.20	Middle Priority
delay in work	1.0.2.1.1.2 - Design Modifications to RR low level RF system	Threat	Grossman, Nancy	13	resources not available	takes longer than scheduled	delay in work	Risk is resources used by higher priority projects. Tasks have some float and contingency to cover this.	0.20	Middle Priority
efficiency is low	1.0.4.1.3 - Evaluate Slip-Stacking Performance for ANU	Threat	Grossman, Nancy	22	limitations of slip-stacking proocess such as beam loading compensation	losses are higher perhaps limiting beam power	efficiency is low	We are slip-stacking now in the MI and working to understand the slip-stacking process and improve it to then apply it to slip-stacking in the RR for ANU. This work is on-going and thus there is a lot of time to improve knowledge of slip stacking.	0.14	Middle Priority
takes longer, costs more than base cost	1.0.3.3 - NuMI Target Hall Infrastructure	Threat	Grossman, Nancy	27	designs at conceptual level	takes longer, costs more	takes longer, costs more than base cost	Contingency should cover the costs, most of the schedule impact can be covered with float, depending upon the system affected.	0.15	Middle Priority
magnet won't meet specs, electrocution	1.0.1.2.1.3.13 - Low Voltage & High Voltage Testing of 4th/Final Prototype Magnet	Threat	Grossman, Nancy	59	design not quite righ, person touching HV current source or exposed conductor	reject this design,personnel injury or death	magnet won't meet specs, electrocution	Choosing the best of several different magents to test the most promising ferrite design with potting in the final configuration at high voltage, to reduce the probability of having no successful design. Tests conducted in restricted areas.	0.11	Middle Priority
electrocution	1.0.1.2.1.3.11 - Low Voltage & High Voltage Testing of 2nd Prototype Magnet	Threat	Grossman, Nancy	58	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO Procedures.	0.11	Middle Priority
Ceramic tubes can't be made or damaged in shipment	1.0.1.2.1.2.1 - Oversight for Procure of Ceramic Beamtubes Off Project	Threat	Grossman, Nancy	18	Vendor can't meet dimensional specs or shipper careless in handling or packaging not sufficient.	Can't build kicker magnets as scheduled	Ceramic tubes can't be made or damaged in shipment	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
Vacuum or straightness test failure	1.0.1.2.1.1.4 - Start Ceramic Beamtube Brazing Test	Threat	Grossman, Nancy	16	Vendor can't meet vacuum or dimensional specs	Can't build kicker magnets(or some of them as not enough beam tubes)	Vacuum or straightness test failure	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
magnet won't meet specs	1.0.1.2.1.3.8 - Assemble 3rd Prototype Magnet	Threat	Grossman, Nancy	51	design not quite right	reject his design and use/test one of the other designs or	magnet won't meet specs	Building 3 different magnets to test 3 different ferrite designs at low voltage, filled with fluorinert so they can be	0.20	Middle Priority

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						update/correct design.		easily revised if necessary, to reduce the probability of having no successful design. Contingency in task to cover some level of cost overruns.		
design/tooling/ prep work takes longer	1.0.1.1.2 - Beam Lines (Transfer, Abort& RR 30 Straight)	Threat	Grossman, Nancy	6	can't find parts expecting to find in storage. Design issues come up as designs are finalized.	takes longer than scheduled	design/tooling/ prep work takes longer	Contingency and float in task to mitigate this at some level.	0.08	Lowest Priority
ferrites damaged in shipment	1.0.1.2.1.2.5 - Receive Prototype Ferrites	Threat	Grossman, Nancy	42	shipper careless inhandling, poor packaging	order more ferrites	ferrites damaged in shipment	Vendor has instructions for packaging and shipping to reduce probability of damage. Some contingency to cover cost and some float to cover schedule delay.	0.08	Lowest Priority
Simulations not completed	1.0.4.2.1 - Slip-Stacking Simulation &Optimization for the Recycler	Threat	Grossman, Nancy	79	Simulations not completed	Slip-stacking process notimproved over alreadyexisting schemes	Simulations not completed	We are using several different methods of analyzing slip-stacking. The MI and P roton Plan are improving sip stacking in the present machine. There is contingency and float on this task.	0.04	Lowest Priority
Simulations not completed	1.0.4.2.2 - Recycler & MI BeamDynamics Simulation	Threat	Grossman, Nancy	80	Unanticipated changesand complexity	Sources of instabilities and emittance growth notfully understood	Simulations not completed	Use different code and teams for analysis. contingency and float in this task to mitigate.	0.03	Lowest Priority
Measurements not completed	1.0.4.2.3 - MI Machine Measurements	Threat	Grossman, Nancy	81	Unavailability of machinetime or instrumentation	Unavailabilty of machine data which would be inputs to analyses andoptimizations of performance	Measurements not completed	Develop automatic measurement techniques and parasitic studies. Some contingency and float on this task to mitigate this.	0.08	Lowest Priority
Measurements not completed	1.0.4.2.4 - MI Loss Pattern Measurement	Threat	Grossman, Nancy	82	Data collection of inadequate quality	Predictions of ANU loss patterns less reliable	Measurements not completed	Develop automatic measurement techniques and parasitic studies. Some contingency and float in this task.	0.02	Lowest Priority
Takes longer to do	1.0.2.1.2.1 - Removal of 3 Lambertson Magnets	Threat	Grossman, Nancy	10	Higher than anticipated radiation levels	takes more time and perhaps more people	Takes longer to do	Overall installation risk for ANU is covered in NOvA-doc-1964 (NOvA Risk form) in detail.	0.06	Lowest Priority
Measurements not completed	1.0.4.2.5 - Recycler Machine Measurements	Threat	Grossman, Nancy	83	Unavailability of machine time or instrumentation	Unavailabilty of machine data which would be inputs to analyses and optimizations of performance	Measurements not completed	Develop automatic measurement techniques and parasitic studies. Some contingency and float on this task.	0.11	Lowest Priority
Simulations not completed	1.0.4.2.7 - Electron Cloud Simulation & Analysis for ANU	Threat	Grossman, Nancy	85	Unanticipated changes and complexity	Lack predictions of electron cloud activity	Simulations not completed	Use different codes and teams for analysis. Some contingency and float in this task to mitigate.	0.15	Lowest Priority
Loss patterns can't be predicted	1.0.4.2.10 - Establish Detailed ANU Loss Patterns	Threat	Grossman, Nancy	88	Extrapolation cannot be done accurately – made from imprecise data	Won't be able to predict highly radioactivated areas before operation	Loss patterns can't be predicted	Build upon results of similar Proton Plan studies. Contingency and float in task to help mitigate.	0.11	Lowest Priority
Predictions not maintained	1.0.4.3.3 - Maintain Measurements & Predictions of Performance	Threat	Grossman, Nancy	90	High variability in operations efficiencies	Would not be able to make precise predictions of ANU production for experiments	Predictions not maintained	Choose metrics that are automatically measured, or already compiled for operation. Have some contingency and float on this task to mitigate.	0.04	Lowest Priority
takes longer to do than scheduled	1.0.1.1.1 - Decommission Pbars Devices in Recycler	Threat	Grossman, Nancy	5	unforeseen circumstances in the tunnel	takes more people and/or more time.	takes longer to do than scheduled	Driver is getting quads out of R30 straight so they can be refurbished and reinstalled in the shutdown. Will plan work well ahead of time in detail and look at tunnel conditions in earlier shurtodwns. Details of an overall Installation Risk are covered in NOVA-doc-1964 risk form.	0.09	Lowest Priority
					Specifications are	Time & money will be		Risk details and		

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Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
RR inject., gap clearking kickers don't meet specs	1.0.1.2 - Recycler Kicker Systems	Threat	Grossman, Nancy	93	challenging and rely on quality productions(vendor meeting specs)and a high level of craftsmanship - any of which could cause either of these systems to not meet specs.	used as needed/determined necessary to work to meet the specifications. If the kicker is not fast enough, a double-length slot must be made by injecting only five batches before slipping, reducing the total beam power to NuMI by ~8%.	RR inject., gap clearking kickers don't meet specs	mitigations are in NOvA Docdb #1445, NOvA Risk Form.	0.18	Lowest Priority
Collimators can't collimate beam as intended.	1.0.4.1.2 - Evaluate MI-8 Collimator Performance for ANU	Threat	Grossman, Nancy	21	Beam instability.	losses will be moved into the MI tunnel rather than MI8 collimators.	Collimators can't collimate beam as intended.	Doesn't necessarily limit the amount of beam if we aren't loss limited as a margin is built in for losses in our specs. Will start watching the MI Collimator performance ASAP.	0.11	Lowest Priority
takes longer than anticipated	1.0.2.2.2.1 - MI RF Cavity Pre-install Testing (Existing)	Threat	Grossman, Nancy	12	problems with re-using old equipment	takes longer, requires more manpower	takes longer than anticipated	Contingency and float in task for help mitigate some.	0.06	Lowest Priority
Design takes longer	1.0.3.2.1.1 - Medium Energy Target	Threat	Grossman, Nancy	23	mechanical stresses in window and/or cooling issues	Design takes longer, costs more money	Design takes longer	Have contingency in tasks to cover this and float in the schedule.	0.04	Lowest Priority
takes longer, costs more	1.0.3.3.2.3.2 - Removal & Storage of R-Blocks & Radioactive DS Blue Blocks	Threat	Grossman, Nancy	30	conceptual design,radiation levels, need more dry runs	takes longer, costs more	takes longer, costs more	Costs covered in contingency, base duration conservative. Dry runs folded into the duration.	0.15	Lowest Priority
takes longer, costs more	1.0.2.1.4.1 - Analyze MI LCW & Pond Cooling System Capacities	Threat	Grossman, Nancy	33	conceptual design level	takes longer, costs more	takes longer, costs more	Costs covered in contingency. Based cost and duration relatively conservative. This is tied to RR cooling and is covered in that section also.	0.13	Lowest Priority
takes more time, costs more	1.0.1.1.4 - Recycler Cooling System	Threat	Grossman, Nancy	34	designs conceptual	takes more time, costs more	takes more time, costs more	Costs covered in contingency, except MI-8 pump room. Based cost and duration relatively conservative. This is tied to MI cooling and is covered in that section also.	0.15	Lowest Priority
takes longer, costs more	1.0.3.4.3 - NuMI Electrical Infrastructure	Threat	Grossman, Nancy	31	conceptual design phase	takes longer, costs more	Takes longer, costs more	Costs covered in contingency. Base duration is conservative.	0.13	Lowest Priority
Takes longer, costs more	1.0.1.1.4.6 - Design MI-8 Pump Room Water System Installation	Threat	Grossman, Nancy	35	conceptual design	Takes longer, costs more	Takes longer, costs more	May need further work on cooling ponds, may need further work on PV9 pond pump system, costs covered in contingency, base duration conservative.	0.13	Lowest Priority
cable does not meet spec	1.0.1.2.2.2.11 - RR Injection & Gap Clearing Pre-production Pulser Receive All Cable	Threat	Grossman, Nancy	54	vendor didn't meet resistance and HV specs	re-evaluate kicker specs based on properties of cable as received, possibly order new cable	cable does not meet spec	Vendor pre-qualified. Ordering cable early to allow time for revising kicker specs or ordering more cable. Schedule contains float and contingency.	0.09	Lowest Priority
fluorinert out of stock or out of production	1.0.1.2.1.2.8 - Prep Req & Award PO for Parts & Fluorinert for 1 Proto Cooling Skid F	Threat	Grossman, Nancy	43	fluorinert is an expensive product with few customers and low volume sales	kicker magnets will notwork at high voltage	fluorinert out of stock or out of production	Contingency and float in task to help mitigate. Vendor understands importance of this productand charges a high price for it so there is an economic incentive to keep it in production.	0.06	Lowest Priority
Metrics not determined	1.0.4.3.1 - Start Develop Beam Performance Metrics	Threat	Grossman, Nancy	89	Operational data not adequate for metrics	Would not have a robust procedure for predicting ANU production for experiments	Metrics not determined	Have multiple techniques of different levels of complexity. Have some contingency and float on this task to mitigate.	0.04	Lowest Priority
Simulations not completed	1.0.4.2.8 - Transfer Line Simulation	Threat	Grossman, Nancy	86	Unanticipated changes and complexity	Lack compensating tuning procedure for space charge and errors	Simulations not completed	Use several different codes for analysis. Some contingency and float on this task.	0.03	Lowest Priority
Calculations show higher heat loads/temps	1.0.3.3.3.1 - Target Chase Air Cooling	Threat	Grossman, Nancy	247	More detailed analysis.	Requires more design and construction work to address how to mitigate these high temps.	Calculations show higher heat loads/temps	Check accuracy of analyses/simulations, conduct burn tests on paints. Think this is mainly an ESH issue of outgassing of paints used in chase, not an alignment issue. Exploring different options for adding additional cooling to the chase.	0.13	Lowest Priority

RISKS
WBS 2.0 ANU CONSTRUCTION

Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
Work can not be accomplished as planned	2.0 - ANU Construction	Threat	Grossman, Nancy	92	Lack of needed AD & FNAL resources to accomplish the work	Work to get TD/PPD manpower to help and contract help – takes longer as those people need to be trained/overseen and thus costs more	Work can not be accomplished as planned	See NOvA Risk Form in NOvA-Doc-1446.	0.38	Top Priority
Insufficient manpower, takes longer	2.0.3 - NuMI Upgrades	Threat	Grossman, Nancy	39	Operational issues require people and/or higher priority projects.	Takes longer to complete work.	Insufficient manpower, takes longer	See NOvA Risk Form in NOvA-Doc-1446.	0.35	Top Priority
takes longer, costs more	2.0.1.1.4 - Recycler Ring Cooling System Modifications	Threat	Grossman, Nancy	36	designs conceptual	takes longer, costs more	takes longer, costs more	Costs covered in contingency, except MI-8 pump room. Base cost and duration relatively conservative. This is tied to MI cooling which is included here.	0.20	Middle Priority
costs more, takes longer	2.0.1.1.4.5 - Install MI-8 Pump Room LCW System	Threat	Grossman, Nancy	37	conceptual design	costs more, takes longer	costs more, takes longer	Costs covered in contingency, base duration conservative. But an additional pond pump is not covered in contingency if needed.	0.20	Middle Priority
ferrites damaged or out of spec	2.0.1.2.1.1.2 - RR Inject Prod Kicker Receive Ferrites for All Magnets	Threat	Grossman, Nancy	60	vendor didn't meet dimensional tolerance specs or shipper handling was careless	order more ferrites	ferrites damaged or out of spec	Ordering extra to allow for rejects. Have contingency to cover some cost overruns.	0.17	Middle Priority
load resistors damaged or out of spec	2.0.1.2.1.1.4 - RR Inject Prod Kicker Receive All Load Resistor Parts for All Systs	Threat	Grossman, Nancy	61	vendor didn't meet resistance or dimensional tolerance specs or shipper handling was careless	order more resistors	load resistors damaged or out of spec	Ordering extra to allow for rejects. Contingency can cover some cost overruns.	0.17	Middle Priority
Ceramic tubes damaged	2.0.1.2.1.1.5 - Procure 15 Beamtubes for RR Inj from TD Inventory	Threat	Grossman, Nancy	62	Careless handling	Reduced number of spares, down ton adequate number needed for project	Ceramic tubes damaged	See NOvA Risk form NOvA-Doc-1444.	0.14	Middle Priority
Ceramic tubes damaged or out of vacuum or dimension	2.0.1.2.1.1.8 - Receive Kovar Brazed Ceramic Tubes	Threat	Grossman, Nancy	64	Vendor didn't control process in order to meet vacuum and dimensional specs	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged or out of vacuum or dimension	See NOvA Risk from document NOvA-Doc-1444.	0.14	Middle Priority
load resistors damaged or out of spec	2.0.1.2.1.1.16 - RR Receive & Measure Resistors for 11 loads	Threat	Grossman, Nancy	65	vendor didn't meet resistance or dimensional tolerance specs or shipper handling was careless	reduced number of spares, down to inadequate number needed for project	load resistors damaged or out of spec	Ordering extra to allow for rejects. Contingency to cover some cost overruns, some schedule float.	0.20	Middle Priority
Ceramic tubes damaged	2.0.1.2.3.2.1 - Procure 14 Beamtubes for RR Ext/ MI Inj from TD Inventory	Threat	Grossman, Nancy	70	Careless handling	Reduced number of spares, down to inadequate number needed for project.	Ceramic tubes damaged	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
ferrites damaged or out of spec	2.0.1.2.3.2.4 - Receive RR Extract/MI Inject Kicker Ferrites	Threat	Grossman, Nancy	72	vendor didn't meet dimensional tolerance specs or shipper handling was careless	order more ferrites	ferrites damaged or out of spec	Ordering extra to allow for rejects. Some contingency for ordering more. Some float in schedule.	0.17	Middle Priority
electrocution	2.0.1.2.1.2.4 - RR Inject Kicker HV Testing 1 Pre-production Magnet	Threat	Grossman, Nancy	67	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures. Contingency to cover some coast increases.	0.11	Middle Priority
electrocution	2.0.1.2.1.2.5 - RR Inject Kicker Life Testing 1 Pre-production Magnet	Threat	Grossman, Nancy	68	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures. Some contingency to cover cost overruns.	0.11	Middle Priority

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electrocution	2.0.1.2.3.3.9 - RR Ext/MI Inj Kicker HV Testing RR Ext & MI Inj Magnets in MI-30	Threat	Grossman, Nancy	75	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures.	0.11	Middle Priority
electrocution	2.0.1.2.3.3.10 - RR Ext/MI Inj Kicker Life testing in MI-30 or PS-4	Threat	Grossman, Nancy	76	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures.	0.11	Middle Priority
electrocution	2.0.1.2.5.2.9 - Beam Abort Kicker HV Testing in PS-4 or MI-39	Threat	Grossman, Nancy	77	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures. Some contingency to cover cost overruns.	0.11	Middle Priority
electrocution	2.0.1.2.5.2.10 - Beam Abort Kicker Life Testing in PS-4 or MI-39	Threat	Grossman, Nancy	78	person touching HV current source or exposed conductor	personnel injury or death	electrocution	Tests conducted in restricted access areas under careful supervision with standard FNAL LOTO procedures. Some contingency to cover cost overruns.	0.11	Middle Priority
Takes longer than expected	2.0.1.1.1.14 - Installation	Threat	Grossman, Nancy	8	Unforeseen circumstances in tunnel, overlap of activities in same area, radiation levels higher than expected	Installation shutdown is longer/costs more/requires more people	Takes longer than expected	See NOvA Risk Form in NOvA-Doc-1964.	0.20	Middle Priority
Ceramic tubes damaged or out of dimensional spec	2.0.1.2.1.1.6 - RR Injection Select Ceramic Tubes & Cut to Length	Threat	Grossman, Nancy	63	Careless handling or machine cutting	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged or out of dimensional spec	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
takes longer than base schedule	2.0.3.3 - NuMI Target Hall Infrastructure	Threat	Grossman, Nancy	40	conceptual design level	takes longer than anticipated	takes longer than base schedule	Contingency should cover the costs, most of the schedule impact can be covered with float, depending upon the system affected.	0.15	Middle Priority
Ceramic tubes damaged	2.0.1.2.1.2.9 - Apply Resistive Coating Inside Ceramic Beam Tubes	Threat	Grossman, Nancy	69	Careless handling	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
takes longer, costs more	2.0.3.4 - NuMI Decay Pipe/Hadron Absorber/Utilities	Threat	Grossman, Nancy	32	Designs not finalized, thus unanticipated work/parts required	takes longer, costs more	takes longer, costs more	Costs covered in contingency and base costs and durations are conservative.	0.18	Middle Priority
Installation takes longer than expected	2.0 - ANU Construction	Threat	Grossman, Nancy	99	Unforeseen circumstances in tunnel, overlap of activities in same area, radiation levels higher than expected.	installation shutdown is longer/costs more/requires more people.	Installation takes longer than expected	See NOvA Risk Form in NOvA-Doc-1964.	0.20	Middle Priority
Ceramic tubes damaged, out of vacuum or dimension	2.0.1.2.3.2.16 - RR Ext/MI Inject Kicker Magnet Kovar Braze 6 Ceramic BeamTubes	Threat	Grossman, Nancy	73	Vendor didn't control process in order to meet vacuum and dimensional specs	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged, out of vacuum or dimension	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
Ceramic tubes damaged	2.0.1.2.1.2.1 - RR Inj Weld Bellows &Vacuum Flanges on 8 Ceramic BeamTube Ends	Threat	Grossman, Nancy	66	Careless handling	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
Ceramic tubes damaged or out of dimensional spec	2.0.1.2.3.2.2 - RR Ext/MI Inj Select Ceramic Tubes & Cut to Length	Threat	Grossman, Nancy	71	Careless handling or machine cutting	Redcued number of spares , down to inadequate number needed for project	Ceramic tubes damaged or out of dimensional spec needed for project.	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority
Ceramic tubes damaged	2.0.1.2.3.3.3 - RR Ext/MI Inj Kicker Coat, Weld Flanges & Bellows	Threat	Grossman, Nancy	74	Careless handling	Reduced number of spares, down to inadequate number needed for project	Ceramic tubes damaged	See NOvA Risk Form in NOvA-Doc-1444.	0.14	Middle Priority

RISKS
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Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
NuMI Upgrades & Operations work delayed	2.0.4.4.2 - NuMI Upgrades	Threat	Grossman, Nancy	103	Lack of manpower/funding due to other Lab priorities.	Upgraded workcell, remote handling, horn 1and modules not available for use when needed.	NuMI Upgrades & Operations work delayed	See NOvA-doc-2318 (NOvA Risk Form) for details.	0.42	Middle Priority
Delay in Tevatron Shutdown	2.0.4 - Project Management	Threat	Grossman, Nancy	238	Programmatic changes.	Depending on the length of the delay, this would delay the Accelerator Upgrades shutdown.	Delay in Tevatron Shutdown	See Nova Risk Form NOvA-Doc-2316 for details.	0.21	Middle Priority
Can't re-use items we need from TeV	2.0.1 - Recycler Upgrades	Threat	Grossman, Nancy	236	Tevatron still needs to be operational for protons (lab programmatic details.	Cost and schedule delay to the ANU-sub-project.	Can't re-use items we need from TeV	See NOVA-doc-2641 (NOvA Risk Form) for details.	0.25	Middle Priority
Need additional cooling for chase.	2.0.3.3.3 - Target Chase Upgrades	Threat	Grossman, Nancy	248	More detailed analysis in design phase gives higher heat/temp. numbers.	Need additional time/$ to address cooling issues.	Need additional cooling for chase.	Check accuracy of analyses/simulations conduct burn tests on paints during design phase. Think this is mainly an ESH issue of outgassing of paints used in chase, not an alignment issue. Exploring different options for adding additional cooling to the chase.	0.23	Middle Priority
costs more, takes longer	2.0.1.1.4.5 - Install MI-8 Pump Room LCW System	Threat	Grossman, Nancy	38	insufficient MI cooling pond capacity	could require additional cooling ponds	costs more, takes longer	cost contingency does not include additional pond capacity, should know early in project if this is needed.	0.07	Lowest Priority
copper prices go up	2.0.1.1.2.3 - RR Receive 53 Mhz RF System Copper	Threat	Grossman, Nancy	46	market fluctuations	costs more	copper prices go up	Could be covered by contingency depending upon how much the increase is.	0.13	Lowest Priority
cable installation takes longer than expected	2.0.1.3.1.4 - Recycler Instrumentation Install Cables & Boards	Threat	Grossman, Nancy	47	interference with other activities	takes longer, costs more	cable installation takes longer than expected	See NOvA-doc-1964 (Risk Form) for more details.	0.18	Lowest Priority
transition boards take longer to test	2.0.1.3.1.3 - Test BPM Transition Boards	Threat	Grossman, Nancy	48	Technical difficulties during testing, need to fix some	takes longer, costs more	transition boards take longer to test	Will test as soon as we receive them. There is some schedule float available. Some contingency to cover cost increases.	0.08	Lowest Priority
takes longer than expected	2.0.1.1.1.4.7 - Fabricate, Assemble & Test Magnets	Threat	Grossman, Nancy	9	delays in refurbishment process	installation schedule delays	takes longer than expected	Matching quad strength to desired values is not easy. Will watch task closely and work to minimize delay. Some contingency and float in task to cover cost over runs and schedule delay.	0.11	Lowest Priority
Service buildings not ready when needed	2.0.2.1 - MI Modifications	Threat	Grossman, Nancy	97	Delay in GPP project.	Can not install into buildings when planned.	Service buildings not ready when needed	Some contingency and float in the schedule to cover this.	0.08	Lowest Priority
Anode power supply room not ready when needed	2.0.2.2.3 - MI RF Cavities Cavity Installation	Threat	Grossman, Nancy	98	Delays in the GPP construction of the anode power supply room	Can not install MI RF equipment when scheduled.	Anode power supply room not read when needed	There is some contingency to cover cost overruns. There is fair amount of float on these tasks also.	0.08	Lowest Priority
design is more complicated than anticipated	2.0.3.2.1.1.3 - Construct ME Target at IHEP	Threat	Grossman, Nancy	24	design more involved due to window/cooling design issues	costs more, perhaps takes a bit longer	design is more complicated than anticipated	Contingency in this to cover costs and float to cover schedule time.	0.08	Lowest Priority
installation takes longer than scheduled	2.0.3.2.2.3 - Install hadron monitor in tunnel	Threat	Grossman, Nancy	25	Higher than expected radiation levels, never been done before, off-project items not work as expected	takes longer, costs more money	installation takes longer than scheduled	See NOVA-doc-1964 (Risk Form) for more details.	0.08	Lowest Priority
takes longer, costs more	Carriage, T-Block Supports & Shielding Blocks in ME position	Threat	Grossman, Nancy	28	Unexpected complications alignment problems from past experience, dealing radiation levels	takes longer, costs more	takes longer, costs more	High contingency to cover costs. Base estimate conservative for duration.	0.15	Lowest Priority

RISKS
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Event	Activity	Risk Type	Owner	Risk #	Cause	Consequence	Event	Details	Score	Tolerance
Installation takes longer, costs more	2.0.3.3.3.3.2 - Install additional temp monitoring Equip & Readbacks	Threat	Grossman, Nancy	29	Conceptual design, radiation levels, attaching existing radioactive components	takes longer, costs more	Installation takes longer, costs more	Overall ANU Installation risk covered in NOvA-doc-1964 (NOvA Risk Form) in detail.	0.08	Lowest Priority
RR inject., gap clearing kickers don't meet specs	2.0.1.2 - Recycler Kicker System	Threat	Grossman, Nancy	94	Specifications are challenging and rely on quality productions(vendor meeting specs)and a high level of craftsmanship - any of which could cause either of these systems to not meet specs.	Time & money will be used as needed/determined necessary to work to meet the specifications. If the kicker is not fast enough, a double-length slot must be made by injecting only five batches before slipping, reducing the total beam power to NuMI by ~8%.	RR inject., gap clearing kickers don't meet specs	Risk details and mitigations are in NOvA Docdb #1445, NOvA Risk Form.	0.11	Lowest Priority
need additional stripline kicker	2.0.1.3.3 - Dampers	Threat	Grossman, Nancy	49	Injection and instability damping require more power than current stripline kicker can handle	need to build and install a new stripline kicker	need additional stripline kicker	This kicker is not presently in the project RLS. WIll know early on if this is necessary and thus the impact on the schedule will be low. Some contingency on these tasks, but not enough to cover this cost. Present analysis predict that this will not be needed.	0.09	Lowest Priority
takes longer than anticipated	2.0.2.2.5.4 - MI RF Cavities (2) Installation & Testing Complete	Threat	Grossman, Nancy	14	issues of integrating new cavities with old operational ones.	takes longer, costs more	takes longer than anticipated	Contingency and float in task to help mitigate some.	0.06	Lowest Priority
takes longer	2.0.2.2.1.2 - MI RF Cavities Bus Bar Fab & Install	Threat	Grossman, Nancy	15	difficult installation that has not been tried before	takes longer, costs more money (manpower)	takes longer	Contingency and float in task to help mitigate.	0.06	Lowest Priority
GPP Project gets delayed	2.0.4.4.1 - Recycler	Threat	Grossman, Nancy	102	Funding not available based on Lab priorities.	Buildings not ready for kickers or MI RF when needed.	GPP Project gets delayed	See NOvA-doc-2317 (NOvA Risk Form) for details.	0.15	Lowest Priority
Delay in CD03a or Cd-3b funds vs. schedule	2.0.4 - Project Management	Threat	Grossman, Nancy	237	Delay in review process.	Construction tasks delayed (can't procure).	Delay in CD03a or Cd-3b funds vs. schedule	See NOvA Risk Form in NOvA-Doc-2315.	0.13	Lowest Priority
Gap clearing kicker system not ready for NOvA	2.0.4.4 - Off Project MS	Threat	Grossman, Nancy	235	Delays in funding and/or manpower for completing the off-project work of constructing (and installing in MI) the gap clearing kicker system.	Installation of the gap clearing kicker system for NOvA is delayed.	Gap clearing kicker system not ready for NOvA	See NOvA-doc-2642 (NOvA Risk Form) for details.	0.08	Lowest Priority