Title	***Upgrade Vs. 1.2 and Vs. 1.5 front ends***			
Project Requestor	P. Den Hartog			
Date	3/21/2008			
Group Leader(s)	P. Den Hartog			
Machine or Sector Manager	John Quintana			
Category	Obsolescence/Spares			
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*This row is filled in automatically on check in to ICMS. See Note [1]

Description:

Start Year (FY)	**2009**	**Duration (Yr)**	**5**

Objectives:

Perform Non-destructive testing of front end photon shutters and update existing vs 1.2 front ends for higher current operation to enable operation with higher stored beam currents and/or longer undulators or canted undulators.

Benefit:

Enable select beamlines to operate with longer undulators and canted undulators and prepare for operation of the storage ring with higher stored beam current.

Risks of Project: See Note [2]

None foreseen

Consequences of Not Doing Project: See Note [3]

Many beamlines will continue to be limited to 130 mA stored beam or to the use of a single undulator.

Cost/Benefit Analysis: See Note [4]

Options are presented in the description that achieve varying levels of performance at different cost points.

Description:

This project seeks funding to upgrade or replace the vs. 1.2 and vs. 1.5 front ends to withstand higher stored beam current, and/or alternatively, longer or dual or canted undulators.

There are currently four types of front ends installed at the APS. The oldest and least capable are the vs. 1.2 front ends installed as part of the APS construction project. These 20 front ends are limited to a stored beam current of 130 mA with a UA33 at closed gap (K=2.62 – 11 mm). We do not currently perform routine inspections on our high heat load components sue to the difficulty of access. However, an appropriate inspection program is an industry accepted practice for mitigating the failure risk associated with a decreasing fatigue life. The thermal heat load limits for shutters in these front ends might be increased if a non-destructive testing program was established to monitor for fatigue cracks. As a part of this proposal, we would seek to purchase an appropriate non destructive testing inspection system for in place inspection of existing "hockey stick" shutter blades with the intent of establishing an inspection program that would be used in conjunction with higher power operations on existing front ends. One possibility would be to relax the power limitations on a particular front end, say sector 1 - where the gaps of two undulators are currently power limited - with a plan of removing and inspecting after a suitable interval of high power operation. The vs. 1.2 front end would be replaced with a higher power capable front end funded through this project.

Newer front end designs have been developed for the undulator only (vs. 1.5 in S16, 22, 31, 32) and canted undulator (S21, 23, 24) and High Heat Load (HHL) front end on the IXS and NanoCat beamlines (S30 and S26). Vs. 1.5 can withstand a current of 150 mA of a single undulator A while the HHL front ends can operate with two undulators (UA33 at k=2.62) at 180 mA. The canted undulator front end can accommodate two UA33 at closed gap (K=2.623) with up to 200 mA of stored beam.

Because of the economies of scale achieved by purchasing and assembling components for many front ends simultaneously, it is desirable to purchase components all at once, if possible. Reality, however, may limit available funds. In this case, funding for any number of front ends would still be desirable as it would enable long lead components to be fabricated in advance of actual need.

Replacing all of the vs. 1.2 and 1.5 front ends with HHL front ends or canted undulator front ends where appropriate would provide the greatest increase in performance but is probably not warranted by actual need. The cost of retrofitting a vs1.2 FE with an HHL or canted front end is about 500K$. A more economical alternative would be to acquire the components for a few HHL front ends and 3-4 canted front ends to be used as needed and to acquire components for partial upgrades for the remaining beamlines. The partial upgrades would improve performance somewhere between the existing performance and

the HHL performance. They are estimated to cost between 100K$ and 500K$ depending upon the relative increase in performance. For example an existing replacement shutter design, based on the canted undulator shutters, would allow the vs. 1.2 front ends to operate at 1.5 times the current load capacity. In this case, the shutters would no longer be the load limiting element but the actual power limit is instead limited by a front end mask. If supported by appropriate analysis, the current limit of this mask could be raised based on the fact that failure would not result in an unsafe condition. If this can be done, doubling the thermal load bearing capacity of the vs. 1.2 front ends so as to make them capable of handling two UA33 at closed gap at the present 100 mA stored beam current (which is liketly to remain constant in the short term) would be feasible with an investment of only 100K$ per beamline.

The funding details are based on a plan of 150K$ for a non-destructive testing system, 4 new high heat load front ends and 4 new canted undulator front ends (at a cost of 500K$ each) in years 1 and 2, and 12 upgraded front ends at an average cost of 150K$ each in years 3 and 4.

Funding Details

Cost: ($K)
Use FY08 dollars.

Year	AIP	Contingency
1	2150	
2	2000	
3	1000	
4	800	
5		
6		
7		
8		
9		
Total	5950	10%

Contingency may be in dollars or percent. Enter figure for total project contingency.

Effort: (FTE)
The effort portion need not be filled out in detail by March 28

Year	Mechanical Engineer	Electrical Engineer	Physicist	Software Engineer	Tech	Designer	Post Doc	Total
1	3	0.5			3	0.5		7
2	3	0.5			3	0.5		7
3	4	0.5			4	0.5		9
4	4	0.5			4	0.5		9
5								0
6								0
7								0
8								0
9								0

Notes:

[1] **ICMS**. Check in first revision to ICMS as a *New Check In*. Subsequent revisions should be checked in as revisions to that document i.e. C*heck Out* the previous version and C*heck In* the new version. Be sure to complete the *Document Date* field on the check in screen.

[2] **Risk Assessment.** Advise of the potential impact to the facility or operations that may result as a consequence of performing the proposed activity. Example: If the proposed project is undertaken then other systems impacted by the work
include ... (If no assessment is appropriate then enter NA.)

[3] **Consequence Assessment.** Advise of the potential consequences to the facility or to operations if the proposal is not executed. Example: If the proposed project is not undertaken then ____ may happen to the facility. (If no assessment is appropriate then enter NA.)

[4] **Cost Benefit Analysis.** Describe cost efficiencies or value of the risk mitigated by the expenditure. Example: Failure to complete this maintenance project will result in increased total costs to the APS for emergency repairs and this investment of ___ will also result in improved reliability of ____. (If no assessment is appropriate then enter NA.)